

Aviation Week & Space Technology

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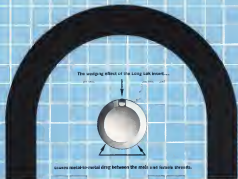
May 7, 1962

SPECIAL REPORTS:

- Bullpup Missile
- USAF Evaluates Helicopters

NASA Apollo Mockup





metal-to-metal drag: with Long-Lok®

Voi Shans self-locking, self-contained drives, Long-Lok, is primarily used in tapered structures where quick installation and removability combine to advantage in cost and time savings—no lock wiring—no lock washers. Further, the Long-Lok fastener can be incorporated into any externally threaded part. Its simplicity is another example of Voi Shans quality production skills.



Long-Lok qualifies to, and exceeds, the 15 times removability requirement of MIL-71824D. RELIABILITY and vibration resistance are prime characteristics of the Long-Lok design. Wide side temperature range (—130°F to 230°F), Long-Loks are available in various NAS Standards such as NAS-1180 through 1191 series. Write for detailed brochure on your letterhead.

VOI-SHAN MANUFACTURING COMPANY

A Division of THE SHAN CORPORATION, INC.
8045 FERNDALE STREET, CALVER CITY, CALIFORNIA

GOODYEAR

IDEA: Space stations run by the sun



LAND, SEA, AIR or SPACE... TALENT THAT BUILDS BETTER DEFENSE SYSTEMS

There's no need to orbit dual with a space station if it's designed to run on solar energy... collected and concentrated by the lightweight equipment which Goodyear Aircraft Corporation (GAC) has under development.

We have technology to fabricate solar concentrators up to 50 in. diameter. Demonstrated horizontal accuracy is ± 0.5 degree. Spectral reflectivity can reach 90%. And they fold into extremely small packages, erect automatically in space, can concentrate enough energy to run electric

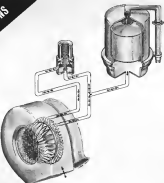
power systems ranging from 5 to 35 kilowatts.

This solar concentrator concept is typical of GAC's capabilities in land, sea, air or space defense systems.

If now is when we can be of service to you in advanced systems and technology—aircraft support equipment—electronic subsystems—lightweight structures—or missile requirements, write now to Goodyear Aircraft Corporation, Dept. 9114AQ, Akron 13, Ohio, or Littlefield Park, Arizona.

Send this ad to a progressive supply growing technical staff. Contact E. W. Smith, Director Technical Personnel.

GOODYEAR
GOODYEAR AIRCRAFT CORPORATION



Positive control of hot gas flow . . . essential element in dependable cartridge starting

The Sundstrand Cartridge-Pneumatic Starter now being delivered to users throughout the free world has been designed to provide complete operating safety consistent with the highest degree of reliability. The advanced design of these starters is a direct outgrowth of Sundstrand's research and development experience in hot gas technology related to various APU systems for missile and aircraft.

The key to the successful development of this new concept has been the adoption of a modular design that incorporates positive control of hot gas flow. Since the semiautomatic cartridge propelled burn line vents with temperature and pressure, each of these variables must be closely controlled for efficient, reliable starting.

The hot gas circuit of the Sundstrand Starter incorporates a pressure sensing valve in parallel with a fixed orifice turbine nozzle. The resulting effect is a variable area nozzle to the gas stream which controls the cartridge pressure to a constant value and minimizes the change in turbine pressure and burn time.

The latest design advancement accomplishes positive control of hot gas in two separate suc-

cess stages. The first stage establishes and controls the burn rate of the cartridge, and delivers optimum mass flow of gases to the second stage for performance requirement. Through the use of correctly sized and shaped nozzles, the second stage pre-expands the flow delivered and establishes the optimum pressure ratio.

These advantages of hot gas control are realized in mass flow and burn time can be established independent of nozzle size. Nozzle pressure can be varied from 7.5 to 47.5 without affecting burn time of cartridge. All cartridge gases are used to drive the turbine. Variation in temperature from -65° to 180° F will cause only slight variation in nozzle pressure ratio.

This inherent control of hot gas technology plus inherent turbine overspeed control and overpressure protection makes the use of the Sundstrand Cartridge-Pneumatic Starter the reliable and safe method to start aircraft engines. The modular design provides the configuration flexibility to adapt the basic starter to your aircraft installation requirements through minor alterations to the starter elements. More detailed information is available at your nearest Sundstrand office.



F-100



F-105



H-195



F-100



C-130B



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AEROSPACE CALENDAR

(Continued from page 5)

- Session, Museum of Science and Industry, Chicago 13. Sponsor: Office of Naval Research, Ames Research Foundation.
- May 12-14—National Microwave Theory and Techniques Symposium, Institute of Radio Engineers, Boulder, Colo.
- May 14-18—Southwest Region Conference on Space Communications, Institute of Radio Engineers, Seattle, Wash.
- May 19-21—International Space Association, Miami International Airport, Miami, Fla.
- May 21—Symposium on Recent Developments in Astronautical Sciences, Institute of the Americas, Southern, Los Angeles.
- May 30-June 2-1963 Annual Wright Memorial Glider Meet. For information: Engineering Society of Dayton, Inc., Per 11th Branch, 7 O. Box 91, Dayton 9, Ohio.
- June 4-7-1962 Nuclear Congress, Sheraton Hotel, New York 17, N.Y.
- June 5-7—Symposium on Standards for Filament Wound Reinforced Plastics, Naval Ordnance Laboratory, Silver Spring, Md.
- June 6-8—Eighteenth Annual Radio Symposium (Invited) series, Institute of Science and Technology's Radio Laboratory, University of Michigan, Ann Arbor.
- June 12-14—Pacific Northwest March Conference, Eugene, Oregon; Portland, Oregon; Seattle, Wash.
- June 15-16—National Maintenance and Operation Meeting, Aeronautics Systems Service, Inc., Building 70.
- June 17-18—South Atlantic Conference, National Aeronautics Education Council, Seattle, Wash.
- June 18-19—Annual Meeting, Heat Transfer and Fluid Mechanics Institute, University of Washington, Seattle, Wash.
- June 17-22—Summer General Meeting, American Institute of Electrical Engineers, Denver 10, Denver, Colo.
- June 18-24—Western Microwave Conference, American Vacuum Society, New York University, New York 17, N.Y.
- June 19-Aug. 12—Advanced Subject Matter Institute on Nuclear Reactor Propulsion, University of Florida, Gainesville, Fla.
- June 20-22—National Science Foundation, 77-15-77th Meeting, Western Electric and Manufacturing, Inc., American Hotel, Los Angeles.
- June 19-22—Summer Meeting, Institute of the Americas, Southern, Anaheim 16, Calif.
- June 20-22—Annual Convention, Aeronautics and Astronautics, American Institute of Aeronautics and Astronautics, New York 17, N.Y.
- June 21-27—North Atlantic Conference on Military Electronics, Institute of Radio Engineers, Southern, Miami, Fla.
- June 19-26—Symposium on Electromagnetic Theory and Antennas, Copenhagen, Denmark, Sponner Technical University of Denmark, International Scientific Radio Union.
- June 26-28—Aviation Conference, American Society of Mechanical Engineers, University of Maryland, College Park, Md.
- June 28-29—25th National Meeting, American Meteorological Society, University of Alaska, Fairbanks, Alaska.

(Continued on page 9)

ACTION MEMO
FROM: Design Engineering
TO: JNH. Dept 47-62.

Look at the size of that blood head, that's the answer to most sheet and dimple applications! Let's evaluate this new!
JNH



For technical data on the new Bulded Cherrylock "1950" Series rivets, write Townsend Company, Cherry Rivet Division, Box 2157 N, Santa Ana, California.

Walter Puckley

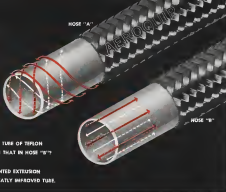


Cherry Rivet Division
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In Canada: Prometec & Bulbed Manufacturing Company, Ltd., Georgetown, Ontario



**QUESTION: WHY IS THE TUBE OF TEFLO
IN HOSE "A" BETTER THAN THAT IN HOSE "B"?**

**ANSWER: A NEW PATENTED EXTRUSION
PROCESS PRODUCES A GREATLY IMPROVED TUBE.**

You get SUPERIOR PERFORMANCE with NEW Aeroquip Hose of Teflon

A year and a half of trouble-free service proves Aeroquip's new Hose of Teflon has superior performance and dependability. The tube of this new hose is made by a process using a counter rotation of the elongated granules (fibers) of Teflon during extrusion. Characteristics are greatly improved over Teflon tubing made by conventional methods in which the Teflon fibers are arranged in a parallel longitudinal direction. For example, the new tube eliminates weepage of fuel and other low viscosity fluids.

Proven acceptable military and commercial performance levels are exceeded by new Aeroquip Hose of Teflon.

Where higher performance requirements exist, enhanced specifications can now be written and met by this new product.

Aeroquip Hose of Teflon is produced in a wide range of fittings. It is designed for use with Aeroquip "wager gram" fittings (MS-F-37273). These fittings are detachable and reusable for quick, easy field extension of hose lines of Teflon. Mail this coupon below for your copy of new Catalog 905 with full info section. It will be sent to you by May 15, 1968. Aeroquip Products are protected by Patents in U.S.A., Canada and Abroad. Aeroquip Corporation, Jackson, Michigan.

Aeroquip



NO WEEPAGE

The "red dye" test proves new Aeroquip Hose of Teflon will not weep carrying 2000 psi fuel and other low viscosity fluids.



SUPERIOR DESIGN

Superiority of the reusable "wager gram" Teflon has been recognized at the new USAF Standard, MS-F-37273.

ORDER YOUR COPY OF NEW CATALOG 104

Our complete information sheet on Aeroquip Hose of Teflon.

☐ Aeroquip Corporation,
Aircraft Division
Please send me a copy of Catalog 104.

Name

Title

Company

Address

City State

AEROSPACE CALENDAR

(Continued from page 7)

- June 26-28—Third International Symposium on Rarefied Gas Dynamics, University of Penn. Park, Penn. Sponsors: AFOSR, ONR, NASA. (Also meeting.)
- June 27-28—North Atlantic Symposium on Computers and Data Processing by the University of Detroit Mercy Research Institute, Ekhon Lodge, Trenton, Pa.
- June 27-28—Joint Automatic Control Conference, Institute of Radio Engineers, New York University, New York, N. Y.
- June 28-29—Fourth National Symposium on Radio Frequency Interference, Institute of Radio Engineers, Town House, San Francisco, Calif.
- July 7-11-1968—Annual 48-Women Transcontinental Air Race from Oakland, Calif. to Worcester, Del.
- July 12-15-76th General Assembly, NALIO Vehicle Camp, Los Alamitos, California and Development, Penn. Plaza.
- July 17-19—Large Machine Marking, Asian Cor. Kevlar Systems, Oak Creek and West for White House, Cleveland, Ohio.
- July 24-Aug. 2—National Sealing Championships 15-16,000 Gold. For information National Sealing Championships P.O. Box 997, Visalia, Calif.
- Aug. 4-10-1968 Standards Laboratory, Civil Service National Bureau of Standards Building, Gaithersburg, Md.
- Aug. 10-12—Forum of Manned Vehicles at Sea and Space, Institute of the Aerospace Sciences, Olympic Hotel, Seattle, Wash.
- Aug. 13-14—Pacific Energy Conference, Cos. Japan, Fairmont Hotel, San Francisco, Calif.
- Aug. 14-16—Cryogenic Engineering Conks, Univ. University of California at Los Angeles, Los Angeles, Calif.
- Aug. 15-17—Nuclear Propulsion, Conks, Univ. University of California at Los Angeles, Los Angeles, Calif.
- Aug. 17-19—Nuclear Propulsion, Conks, Univ. University of California at Los Angeles, Los Angeles, Calif.
- Aug. 21-24—Western Electronics Show and Conference, Institute of Radio Engineers, Los Angeles, Calif.
- Aug. 25-Aug. 27-14th Space Systems International, 14th Air Force Symposium, Air Force Systems Command, Dayton, Ohio.
- Aug. 27-29—Symposium on Ballistic Missiles and Space Technology, Institute of Radio Engineers, Los Angeles, Calif.
- Aug. 28-30—Symposium on Space Systems, Institute of the Aerospace Sciences, Air Force Systems Command, Dayton, Ohio.
- Aug. 28-30—Symposium on Space Systems, Institute of the Aerospace Sciences, Air Force Systems Command, Dayton, Ohio.
- Sept. 3-9-1968 Flying Display and Exhibit, Soc. Sec. of British Aircraft Constructors, Farnborough, England.
- Sept. 10-14—Annual General Meeting, International Air Transport Assn., Dallas, Tex.
- Sept. 15-21-1968 National Conference & Aerospace Exposition, Air Force Assn., Las Vegas, Nev.
- Oct. 25-31—Symposium on Dynamics of Manned Living Fluctuating Safety, 1968, 7th Annual Meeting, Institute of the Aerospace Sciences, Air Force Systems Command, Dayton, Ohio.
- Nov. 1-3-1968 National Conference & Aerospace Exposition, Air Force Assn., Las Vegas, Nev.



reliable heat exchangers

Check with Janitrol the next time you want an oil cooler or heat exchanger. The biggest reason is reliability. The ability to produce production units with the same high quality of the prototype begins with our ability to form flat-iron sheets of stainless steel, titanium and aluminum. We use new techniques for creating optimum heat transfer surface and structural strength in a wide variety of ways. We make heat exchangers and heat transfer systems for liquid/liquid, liquid/gas, and air/air for both high temperature and cryogenic applications.

Ask Janitrol for a proposal when you need heat exchanger reliability on your aircraft, missile, ground support, or electronics cooling project. Request Bulletin JA-141 from Janitrol Aero Division, Midland-Ross Corporation, 4300 Surface Road, Columbus 4, Ohio.

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THE

MARKETPLACE

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Be practical

When the soldering gets tough, crimp because sometimes it just isn't practical to terminate connection by soldering them.

Pole connectors need no solder! For example: After a jet fighter is assembled in the point where connectors are ready to be terminated, workspaces has practically vanished. Under these conditions, soldered-on-the-job terminations are expensive and impractical.

That's probably why many defense manufacturers and subcontractors have standardized on Amphenol's Pole-K™ connectors, especially when a MLC-5005

type connector is needed. "Pole-K's" have removable, crimpable Pole-K™ contacts. Instead of soldering in contacts as a connector, Pole-K connectors are engaged to wires that already have their proper connector location.

Besides ensuring reliable assembly time, the Pole-K method consistently produces more rugged, more reliable terminations.

Amphenol's Pole-K connectors are also widely used in land-based applications. An entire equipment manufacturer, for example, uses Pole-K connectors not

only because they work better and are available with shielded contacts, but also because circuit changes can be easily made after connectors are installed. Anyone who has ever been forced to make circuit changes involving soldered terminations will recognize the value of removable contacts.

Complete technical data, including Pole-K environmental performance characteristics, is available from any Amphenol Sales Engineer. If you prefer, write Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1600 S. 4th Ave., Chicago 38, Illinois.

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AMPHENOL Connector Division / Amphenol-Borg Electronics Corporation

NEW STA-FAST SANDWICH FASTENING SYSTEM

installs inserts in sandwich structures faster, more accurately, with substantial savings



SHUR-LOK INSTALLATION TOOL holds inserts on stud (4 sizes, interchangeable) centered in Installation Anvil. An Adapter Coupling screws onto perforation cartridge. Within the adapter there is a disposable plastic liner with a needle tip which protrudes through a hole in the Installation Anvil, penetrating, pushing compound to flow into sand with structure comp. When cavity is filled, compound appears in upper hole of Insert Flange, visible through View Slot. Installation Anvil provides a sturdy unit for pressing, home the insert. Its smooth, flat surface helps secure flush, firm and fast mounting and saves sandwich facing.

This entirely new concept in insert application and potting is a patented Shur Lok development. It speeds application, eliminates inadequate potting, saves potting compound, ensures flush installation and prevents damage to surfaces. Phone or write for complete data.

NEW SHUR-LOK SL 300 SERIES INSERTS have two holes in the facing flange, and 3 tiny prongs on the rim that press fit to edge of sandwich facing.



SHUR-LOK
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Looking source for specialty fasteners
Locations and Distributors in London, Montreal,
San Diego, Toronto, Vancouver and Paris

New Address: 1380 E. Normandy Place, P.O. Box 1467, Santa Ana, California, Telephone: 547-8866



gold plating on magnesium?

PROBLEM: To combine the sensitivity characteristics of gold with the structural lightness of magnesium for space utilization

BACKGROUND: Engineers have been tarrying, more and more, to the use of magnesium — because of its extreme strength coupled with lightness.

The basic inhibiting factor is the expanded utilization of magnesium has been the difficulty of electroplating with reliability.

SOLUTION: Here, at Burton, we have solved the problem of supplying reliably gold plated magnesium alloy components for the following space programs . . .

1. Pioneer V
2. Ranger
3. Mercury

COMMENT: If you are facing a problem in plating any magnesium alloy, you will find a Burton Engineer as near as your telephone. The number is UFFON 6-8888, in Culver City, California. Or, write us for your copy of our facilities brochure and Technical Bulletin #345. There's no obligation.



BURTON Silverplating Co.

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BURTON SILVERPLATING CO.
1380 Paseo / Culver City / California

Please send me additional information on gold plating magnesium ☐ Please call me ☐ Please have representative call me ☐

Name _____ Title _____

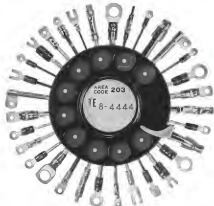
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MAKES ALL TYPES OF ELECTRICAL CONNECTORS



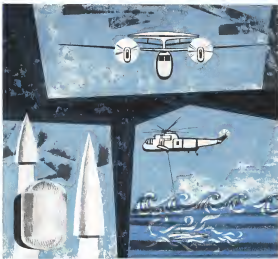
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(look your man up, then call him up)

For the complete line of wirenet® terminal connections... all sizes, shapes and types... call the Burndy man in your area. You'll find him listed right here!

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BRUNSWICK EXCELS IN LIGHTWEIGHT/HIGH-STRENGTH STRUCTURES:

In the fulfillment of space-age requirements for maximum strength/weight ratio, electrical transparency and complete reliability, Brunswick is an acknowledged leader.

An increasing number of successful programs have depended upon Brunswick's fiberglass filament winding process. These include windings for supersonic aircraft such as the F105, F4H, A5F, F105, and the Roman "B" missile. Brunswick's filament-wound rocket

motor cases are currently being used in the Polaris, NASA, and other classified programs.

In laminated plastic structures, too, Brunswick has won the respect of both military and industrial leaders through the successful fabrication of the big 52-foot radome for the Grumman W5F, missile wings, integrated antenna systems, and antenna devices such as "loved fish."

Brunswick's capability has also been demonstrated in model honey-

comb assemblies for jet aircraft, helicopters, reflectors, compasses, shrouds, and other high-strength/lightweight applications.

Working from this wealth of experience, creative engineers and scientists at Brunswick avoid new challenges in still more advanced programs. Can we help you?

Our complete design, fabrication, and test facilities (including electronic test ranges) are at your disposal. Contact us today for your subcontracted competencies.

Interested engineers will find it rewarding to discuss cover features with Brunswick, an equal opportunity employer. Write or call Brunswick Corporation, Defense Products Division, 2700 Washtenaw Street, Kalamazoo, Michigan.



MAKES YOUR DREAM WORK
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CORPORATION



How to get maximum performance from V/STOL aircraft?

The Ryan V/STOL engineering team has the answer. With three military engineering headquarters devoted to four vertical take-off research projects, Ryan is the world's most experienced and knowledgeable specialist in high speed V/STOL aircraft.

Newest and most advanced of these projects is the U.S. Army's VZ-11 research aircraft now being designed and built by Ryan. Powered by General Electric's E85 gas propulsion system, it will be capable of vertical take off, yet cruise at normal flight at more than 500 mph. The VZ-11 concept provides maximum jet thrust augmentation for take-off (up to a multiple 3 to 1 for vertical flight).

In steady state, sea level, flexible, fast moving Ryan is making significant contributions. Ryan is the world's largest designer and provider of Doppler navigation systems and jet target drones. Among other Ryan activities are: Helo Wing applications, electronic systems for lunar landings, and hardware for space vehicles.

All Ryan Aerospace and Ryan Electronics, technical and management capabilities are designed to assure compliance with the most stringent standards.

RYAN AERONAUTICAL COMPANY, SAN DIEGO, CALIFORNIA



VERTICAL TAKE OFF V/STOL RESEARCH As the lead for Ryan's role in its flight and its role in the development of various engine, engine and engine, the Ryan team has been able to meet Army, Navy and Air Force design and development.



RYAN'S V/STOL RESEARCH Ryan's role in its flight and its role in the development of various engine, engine and engine, the Ryan team has been able to meet Army, Navy and Air Force design and development.



RYAN'S V/STOL RESEARCH Ryan's role in its flight and its role in the development of various engine, engine and engine, the Ryan team has been able to meet Army, Navy and Air Force design and development.



To put Rohr deeper into space

this new Rohr hydroclave is curing space age components such as large laminated nozzles for solid fuel rockets... opening the way to larger and more powerful boosters for vital military and space exploration programs. In curing these non-metallic nozzle liner materials, the hydroclave hardens the cost and size barriers inherent in the use of refractory metals. Coupled with our proven facility in fabricating large, precise structures of conventional metals and advanced space age materials, it further reflects the rapid growth of Rohr's aerospace capability. For full information write Marketing Manager, Dept. 108, Rohr Corporation, Chula Vista, California.



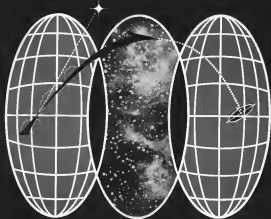
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ROHR CORPORATION

GENERAL PRECISION & STELLAR INERTIAL GUIDANCE SYSTEMS

A contract for production and testing of a Stellar Inertial Guidance System for ballistic missiles has recently been awarded to General Precision by the United States Air Force. Using the stars as reference points, this highly advanced missile-borne system employs a General Precision celestial sensor integrated with a miniature inertial guidance system to deliver the missile to its target.

This is only one in a succession of missile programs for which General Precision's capabilities have been evaluated and found acceptable. Other areas where General Precision has demonstrated competence include Space Vehicle Guidance and Control, Manned Aircraft Systems and Sub-Systems, Air Traffic Control and Instrument Control, General Precision, Inc., Tarrytown, New York, the principal operating subsidiary of General Precision Equipment Corporation.



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GENERAL PRECISION

EDITORIAL

U. S. Space Science

[In his annual report on U. S. scientific experiments in space to the third International Space Symposium sponsored by the Committee on Space Research (COSPAR) in Washington last week, Dr. Richard W. Porter of the National Academy of Sciences stressed the extremely wide scope of this program, particularly in its international cooperation with the scientific communities of the nations represented in COSPAR. Associate Writers & Senior Technology present significant excerpts from Dr. Porter's report.—Ed.]

There has been a year in which the thrill of achieving flight through space by man himself has tended to overshadow the very solid scientific accomplishments that are being made at an ever increasing rate through the use of space vehicles of many kinds. To the scientist, learning to know and understand the physical universe is a completely satisfactory end in itself. To the economist, the business man or the ordinary citizen, space research may be the source of new knowledge and understanding that will lead to new or improved goods and services and thereby a better life on earth. To the philosopher, sociologist, or anthropologist, scientific research in space is a means for gaining new insights into the nature of man and of his relationship with the universe.

Thus it is important not to overlook or to undervalue the importance of the scientific advances to which many competent people all over the world are devoting their lives, whether these advances be large dramatic new discoveries or the accumulation of many small bits of new information that we needed to reveal out the picture and SE in the gaps.

Widespread Program

It will not be easy — to adequately present the accomplishments in space research made by United States scientists during the past year, for the total effort has now reached a level of several billion dollars a year and is being carried out in literally hundreds of government laboratories, universities, and private establishments throughout the land.

During the period from 1 January 1961 to 31 December 1961, the United States launched more than 300 high-altitude balloons (generally to altitudes greater than 25 km), carrying a wide variety of scientific equipment for experiments that could not be made on the surface of the earth or in ordinary aircraft flights, but which could be carried out successfully at the very high part of the atmosphere. A total of 866 synoptic meteorological rockets were launched during this same period, generally at altitudes between 60 km and 100 km. These launches were made from eight different stations, all on the continent of North America.

Special series of launches were made during each of the COSPAR International Rocket Intervals, and at other intervals during the last session. The U. S. also launched more than 70 larger scientific rockets, ranging from the Nike-Cage, which reaches a maximum altitude of about 130 km, to the Javelin which carries a 45 kg. payload

to an altitude of 1,000 km, and the Scout which can lift 70 kg. to a distance of 7,000 km from the earth's surface.

Thirty-one intercontinental artificial earth satellites and deep space probes (a term referring to all vehicles that escape the earth's gravitational field) were launched during calendar year 1961, although it should be noted that several of these, such as Transit 5B-1 and LOFTI, or Transit 4-A, Ispas 1, and Solar Radiation 3, were placed in orbit by a single booster vehicle. Seven two-combination recoveries were made from satellite orbit. In addition, there were seven successful landings in this category during the three years ending 31 March 1962, and two successful recoveries.

International Cooperation

In addition to the extensive list of space projects which the U. S. has undertaken and is undertaking largely on its own, there is a growing activity in cooperative space research, which involves both rocket and satellite experiments such as the satellite (UK) that was successfully launched last week, as well as a variety of international programs for education and exchange of people. These programs are regarded as vitally important in our country, because we look forward to a day when scientists of all nationalities can join in some truly cooperative project to study and explore the universe in the name of all mankind. We regard COSPAR as an important means toward that end; therefore cooperation with COSPAR is a basic element in our policy.

In accordance with COSPAR resolutions, we have not only launched reconnaissance of scientific satellites and space probes, and have distributed current orbital elements for U. S. satellites via SPACEWARN (the international communications network recognized by COSPAR). As recommended by COSPAR, we have submitted detailed scientific information on a number of satellites, and have been working actively on information necessary to be submitted soon for other satellites. We have distributed flight summaries on 1961 rocket flights, many individual reports on rocket, satellite and space probe experiments, cumulative catalogues of space research data, bibliographies, and other information to the World Data Center, also in accordance with COSPAR resolutions.

You will recall that it was through COSPAR that we first offered to provide assistance to other nations in the launching of complete satellites or individual experiments, and in other ways. We continue to look to COSPAR to provide increasingly valuable leadership in organizing international space research of various kinds, such as those that must inevitably be associated with the World Magnetic Survey and the International Year of the Quiet Sun.

Within the limits of our capability we stand ready to cooperate with scientists of any nation on any space research projects, large or small, which will increase man's knowledge and bring him closer to the stars.

Nuclear Shots Test Anti-Missile Theory

Destruction of electrical conductions by big blast could be basis of Russian claim of ICBM defense.

Washington—Current U. S. series of atmospheric nuclear tests in the Pacific will include experiments aimed at proving theoretical calculations that this anti-missile weapon claimed by the Soviet Union is simply a large thermonuclear warhead.

Dr. Harold Brown, director of defense research and engineering, and the test, known as Operation Dominic, "would measure the effects of nuclear explosions carried out in various circumstances on electronic equipment, on other nuclear warheads, as might be involved in an anti-missile missile defense, or on various man-made objects, for example." The disruptive electromagnetic effects of nuclear explosions and other aspects of the tests were detailed in *Aerospace Week* last Mar. 19 (p. 25).

Sen. Clinton P. Anderson (D-N.M.), former chairman of the Joint Congressional Atomic Energy Committee, and last week that too little is known of the effects caused by nuclear explosions "in addition to the conventional effects of radiation, heat and blast."

"Purposed effect expected to be an ionized trail of ionization, not a high speed gas of a shock, cutting the earth's lines of magnetic, produce long electromagnetic standing waves of such intensity that any electrical conductor, such as wires and cables, that are strung on poles or buried in the ground in straight lines, would have currents of thousands of amperes in short in them, resulting in their destruction by melting."

By comparison, using data obtained from relatively low-level explosions in the past, Atomic Energy Commission scientists have determined that thermonuclear blasts could have produced effects on communications equipment to a depth of 300 ft. below the surface.

That belief that is the principle the Russians discovered with their high-altitude explosions last year and the basis for Russia's claim that it has developed an anti-missile weapon. The U. S. wants to find out to what extent the explosion would create these effects and the coverage of their coverage.

If the effects are as serious as test-

ported, the whole concept of fixed missile installations could be changed.

Other effects that are of concern to AEC scientists are blackout of atmospheric communications, possible neutralization of nuclear warheads or potential destruction of warheads. Sen. Anderson said one aim of the development testing program is to be absolutely sure that warheads which are stored in missile silos after being moved from the country to various missile installations are safe against possible destruction under such circumstances in an enemy attack.

Brown indicated that the U. S. has evidence that Russia conducted nuclear tests in part of anti-missile experiments. The Soviets have been producing "somewhat cloud of anti-missile in a month, maybe a year" in anti-missile work.

Brown also said that it is possible that the Soviet Union possesses an ICBM capable of delivering a 55-megaton warhead.

Other U. S. tests, he said, will be in the nature of development tests, development of new, improved light development of nuclear weapons. Some are in the category of proof tests. In actuality, do experiments on design which have been developed during the more tests and which are an important part of our nuclear capability.

Principles behind the electromagnetic effects from warping U. S. scientists have only been partly understood until recently. Plasma physics as a special field has been created around development of magnetohydrodynamic (MHD) acceleration and electrical power generation which depend on acceleration of ionized gases through a magnetic field. Some AEC work has been done in the higher temperatures and velocity development involved in nuclear explosions.

In experiments at the Nevada Test Site after World War II it was noticed that relatively low kinetic explosions caused these effects. High power power was

systems have carrying electrical power to the lower cities of the West Coast started up the standing waves. Voltage surges caused circuit breakers to open even though the power lines were 30 mi away from the test site.

Plasma, which is a mass of ionized gases, can have an electromagnetic force generated in it when it moves in a magnetic field. In principle for the conventional generation of power, this force would be harnessed by electrodes. The same principle is also applied in plasma rockets but the energy is used to accelerate the gas for the purpose of producing a reaction for propulsion.

In a nuclear explosion where the plasma is elements of times better than the MHD experiments mentioned previously, heated expands and ionizes, producing the motion in the earth's magnetic field to create an electromagnetic force. This increase and de-

Consent Bill Advances

Washington—House last week approved establishment of a private U. S. naval communications satellite system to develop and operate the U. S. segment of a world-wide system. The vote was 315 to 8.

The House action is expected to strengthen the hand of advocates of the measure in the Senate, where there is a determined opposition in supporters of communist overthrow. The handful of government-subsidy supporters in the House were in overwhelming thus did not even put up a fight.

The House action is consistent with the law required by the Administration. Amendments offered were of such little significance that they were either accepted or turned down on voice vote, with one exception. An amendment by Rep. Mike Mans (D-Calif.) to prohibit language directing the Federal Communications Commission to develop a communications system in the event of emergency of ground stations was defeated on a 115-0 vote.

The expenditure would be a maximum of \$500 a month and \$100 of which would be reimbursed by communications common carrier. It would be managed by 13 directors as directed by federal law established by the present policy, in addition by holders of stock in communications common carriers and those appointed by the U. S. President.

An amendment by Rep. Emanuel Celler (D-N.Y.) to extend the term of the president's appointment to six years was accepted by the opinion of the 308

majority of intensity extremely apparent and cuts the earth's atmosphere. The earth is a powerful standing wave. Underneath cables will not be affected because air water is a relatively good conductor.

Nuclear explosions create electromagnetic waves not only in the long range but over the entire radio, infrared, visible light and ultraviolet spectrum. They also produce complex particle radiation in addition to heat and blast.

President Alerted

It was after the Russian series of nuclear tests last fall that AEC scientists alerted President Kennedy to the possible use of the larger yield thermonuclear weapons to disrupt or destroy communications. One Soviet test explosion was estimated by the AEC to have produced a yield of 55 megatons, or the equivalent of 58 million tons of TNT.

No direct reference has been made publicly to the effects on ground communications. But Brown revealed that these explosions of thermonuclear devices will be made at 30, 230 and 500 airbursts in the vicinity of Johnston Island in June or July to test effects on radio communications and second order phenomena.

The device to be detonated at 30 mi will place it at the edge of the atmosphere but below the ionosphere. It will have a yield of less than a megaton, Brown said. The 230-mi shot will have a yield of a megaton. This places it in the ionosphere. The 500-mi high explosion will be less than a megaton and will be above the ionosphere.

Threat Recedes

All will be lifted to altitude by Douglas T-119 boosters, which serve both as meteorologic range ballistic missiles and space boosters.

The high altitude shots are expected to disrupt radio communications and affect other radio devices by flooding the atmosphere with electrons.

They will also cause a break in the earth's magnetic field but at higher altitudes. "The more power developed, the more high-energy particles from the outer Van Allen belt, where they are normally trapped."

An intense antenna display is expected to result from the shot in the atmosphere and possibly from the others. It will be visible in air jets at the West Coast of the U. S. Residents of the Hawaiian Islands will be able to see the 500 mi altitude explosion.

No eye damage is expected to result because it is normally the superheating of the atmosphere which produces brilliant light. The atmosphere will also act as a shield to reduce the blast range from 500 mi over Johnston Island to Honolulu at 270 mi. At least



MMRB Deployment Scheme Proposed

Deployment scheme for projected anti-missile missile system. Missile launch site shown possible two-stage configuration, part after launch from track. Missile height would be about 24 ft., first stage diameter about 41 ft., second-stage diameter approximately 5 ft. Gross weight would be about 11,000 lb. Each stage would have single fuel nozzle, one fuel nozzle for the first stage nozzle. Control for lower stages is 200 to 2,000 mi. No stage span would be by third termination provision in the rocket motor. Nozzle is projected for deployment at NATO missile and track will have to be designed to be maneuvered over European command posts and bases. Possible requirement will be only few-minute delay before launch. High burning nozzle will be required over entire range of deployment. Track would have to be located against blast of enemy missile attack. Only three members of the missile are expected to be operational after four year development period.

two-thirds of the particle collection from the explosive device will be scattered away from the earth into space and the other third will be attracted by the atmosphere.

Proton space shots fired by the U. S. were made during Project Argus over the North Atlantic in 1959. These explosions were at the low altitude range and did not affect the earth's

magnetic field to the extent expected in the planned series. But that inert particles into the Van Allen belt which returned triggered similar events in 1958. A thermonuclear device was exploded 45 mi over Johnston Island. That shot disrupted communications. The flash was seen in Honolulu, although the altitude was not high enough for the actual explosion to be seen there.

New Theory Given on Outer Belt Electrons

By Philip J. Kline

Washington—Analysis of recent data from Explorer 12 and several Discoverer capsules indicates that the electrons in the outer Van Allen radiation belt exhibit three different intensity-energy spectra, suggesting that each is produced by a different process, which would explain some of the apparently conflicting data returned by earlier satellites.

In a report to the Third International Space Science Symposium held, sponsored by the Committee on Space Research (COSPAR) of the International Council of Scientific Unions, W. C. Wilcox of the Goddard Space Flight Center said the bulk of electrons in the outer belt, with an average peak activity at energy levels of 600 keV, appear to result from neutrons during their passage on last from the satellite belt by cosmic ray scattering.

A second group of electrons in the belt, whose density falls off sharply with increasing energy level and which have a maximum energy of about 135 keV, sometimes is found in pockets not available at other times it is not found at all. Electron source is not known.

The third type, with energy levels up to about 200 keV, shows large time fluctuations and is found in the innermost zone. Irregular pulses of electrons with similar energy spectra measured in the innermost zone suggest they squirt down along lines of earth's magnetic field.

Heavy cosmic ray particles from galactic space, which travel at enormous speeds, may cause ionization spectra in

the form of the cusp—which probably will disappear as an ionosphere's last layer. However, they are not expected to form the lower or other regions of the belt. H. J. Curtis of the Brookhaven National Laboratory, reported to the conference. These conditions are based on data using the Brookhaven 50-mv cyclotron to produce a 32-mv electron beam with some of the biological effects.

It would be prohibitively expensive in terms of space vehicle payload to attempt to shield against such heavy galactic cosmic particles, and the shielding might actually aggravate the situation by slowing down the particles, which would deposit more energy and do more biological damage, Curtis said.

In other reports, presented to more than 600 scientists from 21 countries, the following information was reported: • Atmospheric density has decreased by a factor of 80 since 1957-59, based on recent measurements made using the Explorer 9 satellite. William J. Oksavala, Jr., of the National Aeronautics and Space Administration's Langley Research Center reported. The satellite, launched February 16, 1960, is at 32 H in the inflated sphere. An density compared from changes in orbital altitude was 1×10^{-12} gram per cc at an altitude of about 570 km, one-tenth that published in the 1955 ARLC Model Atmosphere.

One possible explanation is that the higher density measurements were made at the peak of the 11-year solar cycle, whereas the Explorer 9 measurements were taken near the minimum.

joint in the cycle. This suggests that the decrease in solar activity allows the upper atmosphere to cool and shrink closer to the earth so that the density at a given geographic altitude becomes less.

• Variation of atmospheric temperature and density with altitude, both calculated (Mitsunaga) indicated from the sun and led to outer capillary (particle) radiation, Luigi G. Jorjova of the Smithsonian Institution. Atmospheric Cherenkov radiation is ignored. He estimated that the component was responsible for 30% of noise of the upper atmosphere heating. It has a normal atmospheric and also increases during magnetic storms which occur approximately every 37 days.

• Radio ducts through the ionosphere, which permit high-frequency signals to pass through with little attenuation, have been observed in recent experiments using sounding rockets. NASA scientist reported. The ducts, which appear to be aligned with the earth's magnetic field, were observed up to an altitude of 1,000 km, apex of the rocket trajectory. On one flight, down during V-4000 probe, 15 ducts were encountered above 190 km of trajectory, with the median chord cut across those ducts being 1.4 km. The report was jointly authored by Thomas E. Van Zandt, Wynne Gilbert, Robert W. Kerech and George B. Cox.

• Very low frequency resonances, once thought to be generated by lightning discharges on earth, may be due to positive-charged particles from the sun ionizing with the ionosphere to amplify energy waves, according to a study of ionized by K. I. Masuda and Isao Kurihara of Kyoto University in Japan.

• Detailed analysis of altitudes of electrons from the sun at 280 km altitude in various regions and not uniform, but as an outlier position, according to a report presented by E. A. Hall, K. R. Dimes and H. E. Hestegren of Air Force Cambridge Research Laboratory. They concluded that data obtained from an Aerobics III rocket carrying a special spectrometer, launched Aug. 21, 1961, which reached an altitude of 225 km.

• Existence of a shot layer at an altitude of about 60,000 ft, whose origin is unknown, was confirmed by a magnetograph located to 60,000 ft by a balloon, according to a report by Gordon Norrick, Jr., of the High Altitude Observatory at Boulder, Colo. (University of Colorado at Boulder). The experiment also showed that the number of fast ionospheric particles flowing in the ionosphere below 50,000 ft is so small as to be negligible, to have any significant effect on terrestrial weather.

DOD to Concentrate on Military Space Role

Washington, D.C.—Defense Department will give increasing attention in the next six months to the military mission in space, Robert L. Gilpatric, deputy secretary of defense, told an Air Force Systems Command management conference here last week. Military space activity has not received nearly serious budget attention in DOD since the end of World War II, he said. "We will get about one percent of our budget in space in the next six months," he said, "we will get about one percent of our budget in space in the next six months."

Gilpatric also qualified several other areas and projects due for DOD attention in the next year.

• Administrative and support activities: Need for 300-600 each satellite to replace present 100-150 and other space station and support and funds for such programs will be in the Fiscal 1964 budget, Gilpatric said.

• General purpose base activities: Adequacy of existing base facilities and facilities for handling two contingencies at the same time will be seriously studied, Gilpatric said.

• Improved management techniques: These, Gilpatric said, will include more uniform field controlling management, review of operating systems to cut paperwork, revision of past and present review to cut the publishing number of such reviews as all levels, and reduction of unnecessary specifications.

Gilpatric noted criticisms that DOD was concentrating more and more activity in its own hands. "You guys," he said, "I would have had more and more activity in its own hands, and reduction of unnecessary specifications."

A major defense reorganization would be both controversial and time consuming, and Gilpatric said the more gradual evolutionary process of change was better way to meet in the future method.

Soviet Venus Probe Experienced Intense Van Allen Belt Radiation

Washington—Intensely penetrating X-ray emissions of 130,000 electron volts were experienced while the Soviet Venus probe in its second orbit around the planet Van Allen radiation belt at an altitude of 21,000 to 33,000 mi., Soviet Ambassador A. A. Ilguzinov disclosed here in a report to the Third International Space Science Symposium, sponsored by the Committee on Space Research (COSPAR).

The intense radiation, produced by electrons with energies greater than one million electron volts, may have been responsible for the premature termination of the Venus probe's command communications system, although Ilguzinov did not speculate to that effect. The last radio contact with the probe occurred on Feb. 27, 1961, 15 days after its launch.

On Feb. 17, the Venus probe transmitted data indicating that it was passing through a stream of corpuscular radiation with one billion particles per cubic centimeter per second at a time which coincided with a magnetic storm on the earth. But while the terrestrial storms measured a variation of 30-55 percent in the geomagnetic field, the Venus probe suggested a variation of 2,600 percent in the magnetic field in space, the Soviet scientist said.

The Venus interplanetary station, as the Soviets call it, was launched from its earth orbit while whose apogee was 474 mi. and whose perigee was 148 mi. (APW) Feb. 13, 1961, at 23, Feb. 27, 1961, p. 25). The guidance assembly released in the probe, which the Soviet scientists said came within approximately 62,000 mi. of the planet, reported that its velocity, its altitude, less than 10 ft per second and that it was used to within 0.5 deg.

Venus Probe Instruments

Ilguzinov's report contained a brief reference, which he omitted as delivery, to instruments aboard Venus probe to include which "give range and velocity measurements, but it was not understood whether these were used for velocity control or merely for tracking and estimating trajectory."

The Soviet reconnaissance and that 200 optical tracking systems in 17 countries are said to track both Russian and American satellites. This network has made 15,000 observations during 4,600 passes of American satellites, or an average of 34 observations per pass, the same in 3,000 satellites, of which the Soviet Union has 1,000 observations during 2,600 passes.

The Soviet tracking network also has

made 35,400 observations during 6,500 passes of Echo.

In a brief summary of USSR space program for the current year, Ilguzinov said Russia plans to continue its "technical-biological investigations" during the next mission flight.

Future Experiments

He said the USSR also plans to measure the following chemical particle concentrations in the ionosphere, response to stresses and low energy particles, earth ionosphere belt composition, the geomagnetic field, microwave radiation from the sun and stars, the influence of cosmic rays on space vehicles, and the distribution and production of clouds in earth's atmosphere—an apparent relevance to meteorological type studies.

In marked contrast to the generalized structure of the USSR's space plans was the report on the U. S. program for the coming year, presented by Dr. Robert W. Porter who listed 17 specific types of experiments involving balloons, rockets, satellites or space probes.

X-15 Reaches Altitude Of Over 246,000 ft.

Los Angeles—North American X-15 achieved a record altitude for manned aircraft of 246,700 ft last week in a 15-min. flight by National Aeronautics and Space Administration Test Pilot John S. Wiley.

Record maneuvers altitude was essential because of damage to the windings of turbine engines, but the reading of 246,700 ft is only 3,700 ft above the design altitude of the aircraft plane.

The reading also far exceeds the official world altitude record of 113,600 ft, which is cosmic flight by Ramo. Officers of the National Aeronautics and Space Administration said the flight to Polaris Aerospace International in a world record.

The X-15 was dropped from the Boeing C-130 launch aircraft at an altitude of 45,000 ft over West Lake, Nev., 280 mi. south of the Edwards AFB launch site.

After time for the Lockheed XLR-99 rocket engine to start and burn-out, Wiley accelerated at a speed of 3,645 mph and an altitude of 150,000 ft.

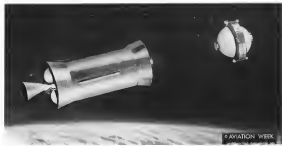
Wiley experienced a 3 g positive deceleration during re-entry at an angle of attack which he deliberately very high in supersonic aerodynamic heating. Nevertheless, his instruments reached 9000° on the cockpit fire.

The flight, made in the No. 1 X-15, was postponed once because the dry lake bed was not drained at altitude landing area for the aircraft was softened by spring tides.



TSR.2's Engine Mounted on Vulcan Testbed

Pratt & Whitney engines, designed as powerplant of the British Avonjet. TS.2 engine, a large, light-weight engine, designed for the British Avonjet. TS.2 engine, a large, light-weight engine, designed for the British Avonjet. TS.2 engine, a large, light-weight engine, designed for the British Avonjet.



VIEW IMMEDIATELY AFTER SEPARATION of ANNA-1 satellite from Able Star stage shows both orbiting in the proposed 680 statute-mile altitude path. Mobile telemetry tracking station in Edinburgh will monitor Able Star's ascent, its apogee orbit exit, and separation from ANNA-1. Further in time the altimeter sphere housed in mobile tank of solar cells about 40 in. in diameter. Mounted on the back of solar cells are the optical beacon's sensor flash tubes.

ANNA-1 Scheduled for Launch This Week

By Irving Stone

Los Angeles—First of the two-track (S-B) ANNA-1 geostatic satellites is scheduled to be launched this week from Cape Canaveral, Fla., in an east city direction in a trajectory sequence designed to provide apogee over Alaska for a 680-mile per second orbit with a 107-min period and an inclination of about 10 deg.

A second tracking satellite is scheduled for launch later in the program, to ensure maximum adequate geostatic data. The ANNA designation (JAN 10, pp. 23, 30) is an acronym for Army, Navy, NASA, and Air Force, the agencies participating in the program, which is under the overall direction of Norey's BuWing, with Johns Hopkins University's Applied Physics Laboratory responsible for satellite development.

A mobile tracking van, part of a worldwide telemetry network, will be stationed in Edinburgh to monitor the first experiment for the reception of data in the boost vehicle's second stage system after a long coast period, the reception of the second stage and until the satellite, and the separation of the satellite for independent orbiting.

The ANNA-1 satellite configuration is a 36-in.-dia aluminum sphere based around the middle ring of a bank of solar cells which extend out about 6 in. from the body of the sphere. Equipment in this payload will include:

- Air Force optical beacon, comprising two sets of sensor flash tubes on top and bottom of the solar cell bank.
- Army Space (Sequential Collation of Range) dual frequency transponder.
- Navy Doppler system embodying four CW transmitters.

The experiments are expected to give direct measurements and measurements of the shape of the earth beyond the data streaked with earlier Navy Transit satellite, and to state major geostatic data in each orbit and to the earth's center of mass. The three measurement techniques will afford independent means for cross-checking of data.

- Specifically, the satellite experiments will include position measurements related to angle, range, and frequency.
- Photographs of the optical beacon's omnidirectional flash will provide angle measurements by determination of the

direction from an observation station in the satellite.

The high intensity optical beacon will produce a series of five light flashes (period 5.6 sec apart). It is expected that observation within the circle of visibility will be able to observe these flashes with relatively simple equipment. Download of the optical beacon is that the beacon's power consumption will be very large, thus limiting the number of flash sequences per day to perhaps 20 or less, depending on whether solar cell exposure to sunlight for recharging the nickel-cadmium batteries. That power limitation will prevent the omnidirectional sequencing of light flashes, which will have to be scheduled to provide maximum stress in geostatic data. A clock mechanism controls eight of beacon timing.

- For range determination, a transponder in the satellite will be equipped with geostatic transmitters which will emit a pulse comprising a modulating frequency as transmitted in, and returned from, the satellite. These frequencies in the VHF/UHF bands will be used—two for transmission to the satellite, and two selected frequencies for transmission from satellite to ground. Analysis of the difference in phase shift on the two returning frequencies will permit a correction for refraction effects.

Four modulation frequencies will be used to resolve ambiguities in distance direction from an observation station in the satellite.

measurements. The satellite transponder system will be designed as all bands, but transmitters will be off except during satellite maneuvers.

Interrogation will be possible only during six or seven passes in each 24-hr period because of satellite power limitations, hence the satellite will be available for use only by one ground complex. To keep satellite measurements simple, the ground station will be linked by a VLF timing net and will transmit in bands so that signals from the various stations will be received separately by the satellite. Complex ground facilities required for interrogation and measurements, together with limited power available for the transponder will not permit sensor data to be available to the scientific community.

• Range rate information will be obtained by observation of the Doppler shift of the satellite measurements from the satellite and from frequencies will be broadcast continuously for this purpose. Frequencies for geostatic measurements will be 161.324 mc with a 54.234 mc per second for refraction studies and as a backup in event of loss of precise timing frequencies.

All four frequencies will be coherent, so that tracking can be accomplished using any two. Transmitters will have low power draw, hence will be left on continuously to be available to observers throughout the world, but ground facilities for signal reception and control (the Doppler shift) will be complex and thus may prevent observations by the scientific community.

At approximately 90 sec intervals, two signals will be broadcast from the satellite in phase in addition to one of the Doppler signals. In showing the power shift in orbiting, the Doppler tracking station it will be possible to extract time of transmission of the time signal to better than one-half microsecond. Since the same clock will be used for this timing, against a constant of optical beacon flash sequences, both these observations will be tied together in time. Supplementing these geostatic system observations, satellites will contain a number of experiments related to satellite communications and attitude.

After three months of orbiting, a calibration program will be initiated and the three basic types of measurements will be compared with each other and with temporal survey results to determine if biases exist in any of the instrumentation or in methods of data handling. If biases do exist they will be identified or corrected before survey work can be undertaken on a world-wide scale, which is contemplated upon successful completion of the calibration phase. This survey will be aimed at enhancement of knowledge of the earth's



GLOBAL POLAR VIEW shows how ANNA-1 satellite will be launched in an exactly the opposite from Cape Canaveral, Fla. Events indicated are: (A) Douglas-Thor booster at T+119 sec, (B) separation of Army/Cornell/Space Command Able Star stage leaving at T+120 sec, and (C) Able Star first coast at T+475 sec. Able Star then coasts for more than 26 min; reenters (D) at T+2,090 sec, and is captured into orbit (E) about 12 sec later. Followed (ANNA-1) separation from Able Star stage, which has retro-rockets to slow its speed so it will not collide with payload.

geostationary field and determining location of tracking stations relative to earth's center of mass.

Boost vehicle will be the combination of Douglas, Thor first stage and Army/Cornell/Space Command Able Star second stage, both developed under Air Force sponsorship. Boost vehicle will be launched vertically with down-range heading of approximately 90 deg. Shortly after liftoff, the vehicle will be oriented about its longitudinal axis to achieve a postulated heading of approximately 45 deg. at the start of the push program. After the lift maneuver, the vehicle will be put into a gravity turn along the programmed trajectory.

Guidance of the Thor vehicle will be terminated a few seconds before engine burnout at approximately 115 sec after liftoff. Second stage fire signal will be initiated approximately two seconds later and, when ordnance valves in the stage open, explosive bolts will be blown to separate Thor from the Able Star stage and attachments on the Able Star stage.

At about 230 sec after liftoff, the nose landing on the Able Star will be jettisoned, exposing the payload. Able Star first burning period will continue until about 475 sec after liftoff when

the long coast phase will begin with a geostatic attitude control system engaging the pitch, roll, and yaw functions.

During the coast phase, the Able Star vehicle will cross the Atlantic, pass over the coast of France at about 10 deg. latitude, continue on over the northeast coast of Italy, then the Turkish coast and pass over Ankara about the postulated altitude to reach for surface of mission at the end of coast, approximately 2,050 sec after liftoff. The Able Star second burn phase will begin and continue for about 12 sec to inject the second stage into orbit. At completion of Able Star's second burn period, explosive bolts will be blown for separating stage to separate the payload from the Able Star stage and attachments on the Able Star stage. The second stage will be in the stage work the associated payload (ANNA-1 satellite).

Depending on Thor booster and Able Star second stage performance, the orbit achieved may vary from the proposed 680-mile per second circular path, because the accelerometer which will control Able Star second orbit will have a tolerance which may produce an elliptical orbit with perigee of 680 miles and apogee up to 690 miles per

F-111A Evaluation Results Due This Week

Washington—Results of the evaluation of the two final design proposals in the F-111A (formerly TF3X) tactical fighter competition will be presented May 13 at Air Force Systems Command headquarters by a team from the Aeronautical Systems Division at Wright-Patterson AFB Ohio.

After approval will be presented to the Air Council at the Pentagon May 15. Participants are Boeing-Westinghouse and General Dynamics-Pittsboro-Worth.

Technically, according to some Pentagon officials, the proposals are expected to fulfill the mission requirements. However, additional sources say that the proposals indicate that development costs of the Air Force and Navy versions of the F-111A will reach \$550 million.

On the basis of a proposal of 3,000 aircraft over a period of five years and a target unit cost of \$5 million, the use of the weapon system would be \$5 billion. There is no assurance that the unit cost will be as low as \$5 million, however.

Unhingham Tailer Collapse

Negotiations toward an out-of-court settlement of dispute between Unhingham Aircraft Corp. and a group of distributors who have filed lawsuits proceedings apparently have collapsed and legal wrangling at a Baltimore, Md., court are scheduled to resume May 10 that more than a month's delay.

Distributors who are suing for a re-entitlement and compensation of Unhingham Aircraft Corp. sold American Warbirds that Unhingham rejected their latest settlement offer last Thursday. Under terms of the proposed agreement, Unhingham would have paid \$375,000 over a six-month period.

Raymond E. Unhingham, Unhingham Aircraft president and founder of the F-111, said the nine suits, however, that the two groups were close to settlement. Based on documents at the Patent Office Manufacturing Corp., which is producing the F-111 on order from Unhingham Aircraft, said early last week apparently to discuss financing of production.

Unhingham sources say that the company contracts has deposits for 15 aircraft orders could 135 aircraft at \$12,800 each.

Willard E. Lueders, Patent Office president, reportedly offered to the government financing needs of the company which would amount about \$15 million for Sept. 15, in return for \$400,000 per aircraft.

Unhingham told Aviation Week that the four firms producing model F-111 aircraft are scheduled to roll off the drawing board, a development that would result in the production timetable some March.

If these target figures are included in the package sent to Defense Secretary Robert S. McNamara by the Air Force, with the approval of Dr. Harold Dorn, director of defense research and engineering (DORSE), they will be subjected to the cost-effectiveness review of the staff of Aeronautical Sciences of Defense Command Charles J. Hyde.

Some military officials do not believe that the F-111A can be produced for \$5 million. This point was that the McDonnell F4H-1 fighter will cost the Navy \$2.05 million each. However, the F-111A will cost \$2.475 million each. The F-111B will cost \$2.4 million each with various production.

This point was that the F-111A will have a highly complex variable geometry wing structure, advanced technology, a sophisticated radar system and a tactical data system. A more reliable one, for example, could be used for \$1.5 million. But these officials insist that in the price that has to be paid for an improved weapon system. They say that placing a dollar limitation on approved performance would mark the difference between quality and quantity when compared with the current's defense.

What is being referred to is a rule which has been intensively applied to proposed weapon systems by McNamara (AW, page 26, p. 25). In this instance, the F-111A would be compared with the F-4H-1, which is currently operational and in its growth cycle. This rule says that the percentage of increase in one of the new system over the current one must exceed by more than 10 times the percentage of increase in performance capability. For instance, a 5% increase in performance would not be permitted to result in more than a 100% increase in cost.

Some military officials and DORSE staff members say this approach is a naive one. The advocates of adhering to the rule would be considered naive, they say. The small increase in performance could make that difference, they point out, and the economic capability of the U. S. to afford that increase should be considered.

These same persons concede that neither cost-effectiveness study for the F-111A is available and will probably include components with growth features of the F-111A. This point out that the further delay will not only cause outside contract work but will only result in more delay in both groups.

The original TF3X proposal was being in February, 1965, when McNamara ordered that the requirements of the Air Force, Navy and Army be considered and not to increase tactical fighter

In the coming 15 months of agreement, assessment and goals by DORSE, the project was first concerned by splitting off the extensive design support system in the form of the VAX, advanced lighters and then concentrated so that the F-111A would be produced in Air Force and Navy versions. In effect they will still be there, ready to build the air superiority, multi-mission, reconnaissance and close support systems according to the needs of the two services.

The project team February, 1965, also involved a struggle in the selection of an engine. Three companies were in the competition. The Pratt & Whitney (TF30) was the winner.



Nerva Engine Mockup

Fairchild 25th high speed mockup of Aerojet-General's Nerve engine under engine was built to check and illustrate concepts, which are, from top to bottom: isolated propellant tank, heated bottles for preheating gases, preheated gas on heat of hot hydrogen-bonded hydrogen, hydrogen-bonded turbine, drive fuel tank, and after all control systems, engine control and sensor, drive chamber (containing the engine rotor), liquid hydrogen rocket fuel to the main (propellant tank), hydrogen-oxygen rocket

Soviets Indicate Titov's Success In Orbit May Have Been Extensive

Washington—Soviet Maj. Gherman Titov last week maintained the richest he experienced during his orbital flight, he indicated that the effects may have been extensive, though this has been reported previously.

Titov was a delegate to the third International Space Science Symposium, sponsored by the Committee on Space Research (COSPAR) of the International Council of Scientific Unions, here (p. 28). He was to give a formal paper on his flight last week. Titov said those who say he had space sickness may have been along with him on the flight, but did not use the same things he saw.

"The first signs of sea-sickness were there," they manifested themselves when I made an abrupt movement of my head," he said. "But my symptoms were high, and my symptoms for work was not affected. The last proof of this is that I completed my program."

But a report written by Soviet Astronauts A. K. Belyakov and V. I. Cosmo reported that a sea sickness that Titov would appear here, and "The sensation of dizziness accompanied a significant portion of the flight."

Titov's apparent sensation of the vestibular character were felt progressively, especially when the space pilot turned his head or observed fast-moving objects," the Belyakov report said. After sleep, the symptoms disappeared but were felt up to the beginning of re-entry.

Reference Quitted

The member who leads the Soviet Cosmo delegation, insisted this reference from the delivery of his paper.

In his autobiography, Titov says that the condition was serious enough to make him faint. This was considered as an error in translation by Myron Shupe, the American publisher of the autobiography, who said the word "sick" should have been translated "nauseated" rather than "sick." The passage referring to the experience read:

"When I had become thoroughly accustomed to the weightlessness, as the fifth revolution, I suddenly felt an unpleasant sensation," he wrote. "I felt nausea soon true to time. In order to 'quar' my 'nausea' vestibular system, I consciously found the most comfortable position in the chair and—fainted. The nausea gradually went down, and the nausea became death because I was not able to get up."

First indication that Titov suffered

some illness came last Aug. 13, five days after his 23½ hr. flight, when Prof. Vladimir I. Yezhov reported that the pilot had "impaired sensations" (AW, Aug. 21, p. 31). It is unlikely that any complete report will be made. Medical data on the sickness Titov experienced has been somewhat sketchy and detailed information about the Soviet manned space flight program has been held strictly in confidence.

Maj. Titov said he was the same throughout his flight as by U. S. Astronaut John H. Glenn, Jr., although he had no sea-sickness as it could be said to have been in New York City. Maj. Titov said he saw the particles at sunset of the last stage, and when the astronauts filed. Glenn saw them at sunset on all three orbits and reported them extensively immediately after his flight (AW, May 5, p. 18).

Technical Questions
In a Washington news conference May 2, Titov, confidently declined to respond to questions about his technical mission, and he gladly brushed aside questions about the Soviet training program. For instance, he said, "It is not appropriate for many astronauts" the USSR, training, is not enough to the USSR, but not to "house" any other countries. Pilot Yuriy V. Vostok 3, who has been named as Titov's backup but not identified by name, is "ready for flight," he said. Titov said he had met for Maj. Yuriy Gagarin, the first Soviet space pilot.

Titov and the Vostok 3 landing system is "of no importance" because the spaceship "can be landed at any chosen place."

The Soviet pilot was obviously well coached politically, because he took every opportunity to stress that space cooperation will come with disarmament, and that he and his crew would not be open to the public until a disarmament agreement is reached between Russia, the U. S. and neutral nations to launch space, and that he and his crew would not be considered before they are launched because "we don't see us in the end before we start."

Belyakov is continually declared to say when the next manned satellite will be launched, although he and seven were launched during 1962. He added that the Cosmos 4 satellite (AW, Apr. 18, p. 27), received Apr. 29 after three days in orbit, "has no connection" with the next manned satellite.

There has been no hint as to how the recovery was effected.

Titan 3 Guidance

New York—Air Force Space Systems Division has selected the team of Space Technology Laboratories and Avco Division of Avco Research Aircraft for award of a contract for the Titan 3 guidance package, contingent upon selection of a contractor for Titan 1 and its Titan-40 solid motor (AW, Apr. 16, p. 28).

Feasible in the competition for the Titan 3 guidance package contract were A C Squip Jet Division of General Motors, Autonetics, General Dynamics Equipment, Minneapolis-Honeywell and the AT/Avco team. Other companies which submitted proposals for the guidance package were General Electric, IBM and Kongsberg Rend.

News Digest

Dr. Raymond L. Binghamhoff will become director of National Aeronautics and Space Administration's Office of Advanced Research and Development on July 1. The man is professor of Aeronautical Engineering at the Massachusetts Institute of Technology for the past 16 years.

Federal Aviation Agency and Civil Aeronautics Board last week agreed to give to pass legislation establishing the National Capital Airports Corp. to operate Washington National and Dulles International airports for \$40 million over the overall direction of the FAA. They approved a civil mission to create an entirely independent Washington Airports Board on grounds the experience and competence of FAA would be effectively connected with the body that runs the two Washington airports.

General Electric P8 turbojet engine designed for the North American B-70 Mach 3 aircraft has completed a five-hour flight testing trial consisting of 65 hr of endurance testing, 15 of them at simulated high altitudes.

A. V. Roe Canada Ltd., changed its name to Hawker Siddeley Canada, Ltd., at a Toronto annual meeting.

Commander Eagle Airways indicated that it would again stop a route because to the North Atlantic despite approval of the bid last November by British Minister of Aviation Peter Thorneycroft (AW, Nov. 3, p. 39).

Aerospace Corp. has purchased 50 acres on the outskirts of San Bernardino, Calif., near NASA AFB. Office buildings will be erected on the land to the west, near the Air Force support of AISC's Balistic Systems Division, which is shifting operations to Norton.

U.S. Share of World Airline Traffic Drops

American carriers still handle bulk of traffic, but percentage drops slightly. Japan shows big increase.

By L. L. Doty

Montreal-Scheduled airlines of Japan, Pakistan, Italy and Czechoslovakia last year registered the largest gains in both international and domestic passenger traffic of all the world's airlines, while the U.S. airlines' share of the overall total continued to decline significantly.

Although U.S. carriers still carry the bulk of the world's passenger traffic, their share has dropped steadily to 55% of the total from 59% last year and 64.2% in 1955. Year-over statistics compiled by International Civil Aviation Organization show that U.S. international and domestic traffic rose a bare 2.3% in 1960 while Japan's total rose 6.2% over 1960's volume, Pakistan's was 46%, Italy's 39% and Czechoslovakia's 15%. ICADO reports do not include carriers of Soviet Russia or the People's Republic of China.

Of the 10 top airlines in airline activity last year, Japan, Belgium, Mexico and Venezuela actually experienced a decline in traffic handled last year. On a regional basis, the decline of the Far East, where passenger traffic has been increasing at annual rates of 20% or more since 1955, led all other areas with a 13% gain. Traffic earned by Middle East airlines rose 23%, while European traffic rose 14% and African volume rose 12%.

The most serious problem revealed by the statistics was the severe drop in the load factor of the world's airlines in 1960, load factors fell to 56%, the lowest level reached in postwar years. This represents a total annual seat capacity of about 57 billion seat miles.

Load factor on international operations in the year was 53.8% compared to 56% on domestic services. In the North Atlantic region, load factors fell from 64.2% in 1960 to 59.3% last year.

Traffic on the North Atlantic is down only 9% since 1955, according to the ICADO report, compared with average 20% increase during the past five years. The figures disclose that 53% of all traffic earned five economy class. The number of passengers using special or charter flights declined 55% to a total of 238,450 passengers.

In an expense ledger on financial results submitted thus far, ICADO expects that operating revenues will exceed \$5.7 billion in 1961, but warns that special operating expenses for the year's 50th anniversary climb at more than \$50 billion to give the industry an operating ratio of 97.4% meaning a slight industry-wide loss.

World carriers had ordered a total of 1,011 turboprop transports by the end of 1962 and a total of 996 turbojets, including 29 all-engine aircraft. Of this

accounted for by the airlines of the U.S., U.K., France, Netherlands, West Germany, Italy and Japan.

Volume of mail rose 52 million ton miles, the largest quantity increase in the postwar era. The 20% jump probably can be attributed in part to the transfer of a large volume of mail from the U.S. Military Air Transport Service to U.S. carriers during the year.

In commenting on the growth of mail and economic traffic and the corresponding decline in fuel class traffic, ICADO noted that 90% of all seats offered on flights across the European continent are in tourist class. On the North Atlantic, average passenger load factor class dropped 20%; economy passengers climbed 16%.

The world's airline safety record in 1960 improved slightly over the previous year, although ICADO noted that 1960 was not a particularly good year from a safety standpoint. In 1961, the total of 22 deaths, according to latest figures, was reduced to 19, including 794 passengers who reported. This represents a total of 2.72 fatal accidents per 100,000 aircraft hours flown, lowest level in recent years. Fatality rates per 100 civilian passenger miles in 1960 were 1.10 compared with 1.25 in 1960, 1.02 in 1959 and 1.16 in 1958.

During the year, turboprop aircraft was involved in six fatal accidents that killed 236 passengers, turboprop aircraft was involved in 11 fatal accidents, killing 190 passengers and 80 piston-engine aircraft accidents killed 143 passengers. Also, turboprop aircraft was responsible for less than one-third of fatal accidents, although they accounted for more than one-half of the passenger miles flown.

ICADO said that "incidents in non-scheduled operations cause more problems as a result of the safety of the world picture of air transport safety." It said that non-scheduled operations accounted to less than 5% of scheduled airline operations, but accounted for seven fatal accidents with 255 passenger fatalities—about 30% of the total for scheduled operations.

The report added that the 1960 record showed 13 fatal accidents on non-scheduled cargo flights.

Although Russia is not a member of ICADO, the report estimated that Aeroflot's year-over operating 240,000 revenue miles, and last year carried 21 million passengers a total of 18 billion revenue passenger miles.

The report estimated Aeroflot is operating 1,838 civil aircraft—230 jet and turboprop, and 1,608 piston transports.



Aeroflot Develops High-Density Version of Tu-104A

Russia's Aeroflot has developed a 160-passenger modification of the twinjet, Tupolev Tu-104A, transport. High-density version of the Tu-104A has the same passenger capacity as the Tu-104, which was not scheduled service early in 1959. But the 160 passenger Tu-104A has the same baggage as the standard Tu-104A and Tu-104. The Tu-104A's baggage is stretched 47 inches. Empty weight of the 160-passenger Tu-104A is more than the 78-passenger version. Modified Tu-104A has "practically the same performance, normal range" as the seven-engine, Aeroflot version. Aeroflot estimates that it can obtain equivalent of a 94% increase in its Tu-104A fleet by relatively small outlay for the 160-passenger modification. This, it says, "will provide a saving of many millions of rubles."

Hughes Tool Wants 'Unambiguous, Unqualified' Control of Northeast

By Wad Wright

Washington—Hughes Tool Co. last week told the Civil Aeronautics Board (CAB) that it wanted control of the Northeast Corridor Case that it would not accept less than an "unambiguous and unqualified" declaration approving its control of the airline.

Hughes Tool last told the examiner that if he and the Board "have a genuine conversation about whether Hughes Tool's acquisition of Northeast control is in the public interest, then should we have such control."

In another brief filed the same day, CAB Bureau Counsel Paul Sclafano told the examiner that control of the airline should be approved pending settlement of the New York Florida Federal Case in which Northeast is seeking permanent Florida operating authority. (AW file 15, p. 42).

Sclafano recommended that the review of the case be delayed to give "time and detailed plan" from Hughes Tool as to how it would rehabilitate Northeast if the Florida route were moved.

Furthermore, Sclafano said, upon receipt of the Florida route, Hughes Tool should be made "to place its stock in a voting trust pending a full reorganization of its managerial offices: once only and of other matters which were not developed in this case."

If after such an investigation, North Carolina control was approved, the voting trust would be ended and Hughes Tool

would regain its rights as a controlling stockholder, Sclafano said. If Hughes Tool's application were disapproved, the trust would continue until Hughes Tool divested itself of Northeast stock a short time later.

Hughes Tool's attorney, Chester Davis, told Associate Wad Wright that Sclafano's proposals were exactly the kind that companies would find unacceptable.

Sclafano said that if Northeast control is approved contingent on the need in the near term, Hughes Tool could use the status to work out a financial solution for the airline. During this period, Sclafano and Hughes Tool would have to begin the last stages of reorganization or be faced with a substantial financial drain, without having action on the stock case.

Sclafano urged that the examiner in the near case be required to get specific plans from Hughes Tool concerning reorganization of Northeast before control is approved. Only if these plans are made available should control of the Florida route be considered, he said.

In its brief, Hughes Tool did not spell out any specific financial plans for Northeast, but asserted that Hughes Tool had a net worth of \$250 million, fully owned assets in excess of \$20 million and was operating profitably. As such, the company said, it was in a position to support the airline. Hughes Tool said the business case for the line is more than \$16 million investment in Northeast would prove the

most reliable guarantee for future support of the airline. Hughes Tool and its support would need no expanded competitive service.

Briefs were filed May 2, after a two-day postponement. Most observers now estimate the examiner's initial decision will be rendered by May 14 (AW file 33, p. 41).

Transpacific Record Reopening Is Sought

Washington—Pan American World Airways has asked Civil Aeronautics Board to reopen the record in the three-year-old Transpacific Route Case to re-evaluate the route's traffic and passenger carrying capacity, and to permit U.S. transpacific carriers.

Pan American said the move is needed to seek a "complete solution" reached when CAB Examiner William F. Madden was unable to decide two of three major issues in the case's international phase in his recommended decision last month (AW file 9, p. 41).

Madden said he had decided that "no valid findings" concerning Pan American's or Northwest's patterns of service, their corresponding capacity or the effectiveness of capacity controls could be reached as the basis of the record. Madden had recommended a U.S. route from Honolulu-Tokyo route for South Pacific Airlines.

CAB had earlier overruled agreements made at a prehearing conference which would have allowed examination of traffic forecasts and service proposals as a basis for evaluating proposed capacity problems and restrictions, and closed the record last September.

ALPA Stand on Anti-Noise Action Is Obscured by Conflicting Views

Washington—Air Line Pilots Assn. position on what anti-noise procedures it should tolerate was obscured last week by two contradictory interpretations—one from the union's headquarters, the other from its eastern region.

In a nine-point program presented to the Federal Aviation Agency's New York office, ALPA eastern region pilots urged that power reductions "earlier or to a greater extent than is done on a normal takeoff" be banned by the agency.

About simultaneously, the union's eastern membership received an internal publication called "Turb. Tak" that reaffirmed ALPA's adherence to the common ban on power reductions and published by the National Aircraft Noise Abatement Council (NANAC).

Under these criteria, power reductions made to avoid violating those in noise sensitive areas are permissible above 50 ft. Many pilots in ALPA's eastern region and elsewhere have contended that FAA-embodied procedures such as this compromise the safe operation of a jet transport.

FAA has reportedly denied that this is so (AVN Apr. 30, p. 16).

NANAC is composed of ALPA, Aerospace Industries Assn. and Air Transport Assn., but less than 90% of its members is furnished by ALPA and AIA. Within ALPA, there is a faction that favors either withdrawing from NANAC or changing its approach to the problem of noise abatement.

ALPA's union abatement policy, passed in 1950 by its board of directors, says that members will adhere to comply with procedures "which is the intent of the pilot advisory effect safety, and the central safety chairman (of each airline) shall be satisfied independently of situations where unacceptable procedures have been indicated." The safety chairman, working through his airline's master executive council, is to take prompt action aimed at securing "acceptable" procedures from company executives and engineers.

Demand made by ALPA's eastern region generally were interpreted as an overstatement of the case against any tightening of noise-procedure standards in FAA's "Red Book." For example, the pilots would have all takeoffs below 600 ft., while FAA permits such takeoffs as long as bank angle is kept below 30 deg. At 500 ft., FAA's maximum bank angles of up to 25 deg.

Eastern region pilots also urged elimination of all noise abatement procedures in weather worse than 1,000 ft. ceilings for 3-in. visibility, and the elimination

of all preferential runway replacement in wet runway conditions.

Crosswind components for both sides of and landing should not be greater than 10 kt., nor should FAA permit downwind takeoffs with more than 5 kt. effective tailwind. During takeoff and climb, the pilot would have all radio transmissions except those needed to communicate with "normal traffic control facilities."

ALTA Supports Boyd On DC-3 Replacement

Atlanta—Development of a DC-3 replacement and means of reducing the local service airline industry's already full were key issues discussed last week at a quarterly regional meeting of the Assn. of Local Transport Airlines.

The group supported a proposal by Chief Executive Board Chairman Alan S. Boyd, who urged development of such an aircraft and indicated that the Board might seek Federal funds to assist the project (AVN Apr. 16, p. 49). ALTA favored a replacement to replace the major problems of design and operation of the short-haul replacement.

It was pointed out that the development also has the backing of Sen. A. S. Mike McColley (D-Ga.), chairman of the Senate aviation subcommittee, and Rep. John Bell Williams (D-Miss.), chairman of the House Subcommittee on Transportation and Commerce.

Three general objectives were outlined for the replacement, which is under the chairmanship of Atlanta-based President Leslie G. Bowers:

- Sound economic development of an aircraft adaptable to low density routes and the full volume of commercial air anticipated at the smaller cities.
- Application of Civil Air Regulations now in effect for air taxi services to local service operation of a DC-3 replacement.
- New CAB rules covering the proposed new type of operation.

Rep. Williams, addressing the group, urged that the government spur research on a DC-3 replacement on grounds that it was "convinced some that valuable cannot be discarded until there is an aircraft specifically designed and built for the needs of the local service carrier."

ALTA also appointed a second new task force to study a means to reduce both industry and Federal regulatory controls, in response to President John F. Kennedy's transportation message which carried a plea for a "biventric interstate transportation network."

During the development of the airline's fleet and new industry forecasts as a joint effort between the industry and CAB, the association sent a policy statement to the CAB suggesting a similar effort to strengthen the local service industry while reducing reliance on a "monopoly" "operated with congressional policy respecting requirements of air services to smaller communities."

Labor Disputes Go On Despite U.S. Efforts

Washington—Labor problems continue to plague the airline industry last week despite intensive efforts by government regulators to settle long-standing disputes between several truck carriers, the Air Line Pilots Assn. and the Flight Engineers International Assn. Acquiescence of the Foreigner Commission report on crew complement by both sides was considered the major answer to resolving outstanding issues between the following companies and unions:

Texas World Airlines and Eastern Air Lines were both urged to adopt the Passenger recommendations in their entirety, in separate Presidential Executive Board reports issued by the National Mediation Board. Ruling in disputes between the two airlines and the FEIA, the board declined to explore the complex jurisdiction battle between the unions but gave full support to Passenger's recommendations calling for a three-man crew on turboprop aircraft and excepting between the two unions and pilot training for the flight engineers.

Wage increases totaling about 15% over a three-year period were recommended by NMB for TWA flight engineers, and an increase of 18% was recommended for the Eastern flight engineers.

However, FEIA's major proposal to reduce monthly flight hour limitations to only 70 hr. on both carriers was rejected by NMB on grounds that there was too little justification.

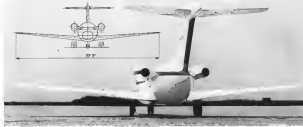
Pilots of Texas World Airlines last week held to a May 1 strike deadline threat and advised the NMB that ALPA and TWA had reached an agreement on rules, working conditions and pay increases. Crew complement was not considered a part of the problem and would be handled as a separate issue, the union said.

Meanwhile, efforts continue to go on to secure agreement between Pan American World Airways and ALPA. Spokesmen for TWA and the union of the aircraft train, which does not include participation by the FEIA, might influence the final outcome of its dispute with the pilots' union.



Netherlands Fokker F.28 twin-turboprop short-range transport shown in model form, is a design and marketing stage company will seek passenger development funds and in negotiating with Boeing, Lockheed, and McDonnell Douglas for cooperative agreement. Two engine aircraft has not been made. F.28 can carry 3,400 lb. of fuel, has 47,500 lb. maximum landing weight.

Fokker Unveils F.28 Short-Range Transport Design



During pilot call for flight test in 1965, first deliveries to 1966-67, F.28 would carry 1440 passengers over 200-1,600 mi. stage lengths at maximum cruise speed of Mach 75. Fokker plans to use turboprops of 3,200 hp. thrust. Note straight wing. Gross takeoff weight would be 50,000 lb. Aircraft is 87 ft. 7 in. long, height is 25 ft. 2 in., open at 77 ft. 10 in.



DULLES TERMINAL INTERIOR shows steel framework for control tower housing airline ticket counters on one side, concessions on the other. Tensile object on center is radome where dishes designed to carry 12,500 pps from roof to stem down and artificial lake.

Progress Report on Washington's International Terminal: Part 2

FAA, Airlines End Debate on Dulles Fees

By Robert H. Cook

Washington — Federal Aviation Agency in a series of major policy decisions has decided upon the financial underpinnings for Dulles Airport, but only expenses will prove whether they are self-sufficient.

N. E. Halsey, FAA administrator, last week declared that the agency had made its decision on the airport's financing. He said the airport will be financed by a combination of federal and state funds, but that the airport will be self-sufficient.

FAA and an airline negotiating committee reached tentative agreement on a landing fee of 30 cents per 1,000 lb of gross landing weight of the aircraft, 50 cents per mobile ramp, and 10 cents per mobile ramp. Landing rates range from \$10 per square foot for ticket counters to \$7.50 for baggage.

There are other charges, Halsey predicts, will make Dulles a money-making airport 20 years from its opening date. He said the airport will lose money in the first decade, "maybe" break even in the second decade and make a profit in the third.

Objective of the FAA is to recover over the next 10 years, \$75.8 million of the total \$106.8 million cost of Dulles, including the airport access highway. He said FAA left the full amount should not be designated for recovery because in other areas such as parking would receive matching grants from the federal government. The congressional appropriations committee refused those target recovery figures, according to Halsey.

All rates will be increased annually as the prices that both the government and the airlines should share equally the value of air traffic modernization and expansion. Halsey noted, but also said that the rates will be included in all contracts in period that renegotiation. In arriving at the total cost to be recovered from airlines and business fees, Halsey and FAA evaluated \$13 million spent on early stages in development of the mobile lounge and construction of the access highway.

While Halsey expressed confidence that the airlines will sign a letter of intent approving the fees in the next few days, several informed observers were quick to note that any disagreement between the heads of major airlines would delay final action by the agency on a week.

The agreement with the airlines was negotiated against a background of industry fear that the FAA was setting an expensive precedent by demanding that the carriers equipment facilities while municipalities usually build themselves and then sue to question. Several industry leaders predicted this arrangement would encourage others to follow suit.

Airline fees set the amount of private FAA and Civil Aviation Board would turn to get airlines to use Dulles instead of Friendship International Airport near Baltimore. Mid-Atlantic said publicly that he was "apprehensive" in this campaign, but Halsey said the House Appropriations and Transportation Subcommittee last week that he never used the agency's regulatory power to push the airlines into using Dulles.

However, CAB Chairman Alan S. Boyd has notified the Reference Airport Board that airlines committed to serve Washington, D.C., must use either Dulles or Washington National Airport. Until recently, Friendship was an alternative for lines serving Washington, but from now on a separate certificate will be required for serving Friendship.

Rep. Howard W. French (D-Md.), a member of the House Commerce Subcommittee, last week said the money spent by Dulles was a doubtful investment considering that Friendship could serve the same need and would cost less business to Dulles. Halsey, conceding there would be a temporary setback to Friendship, replied that airlines business eventually would grow to the point where all three airports in the area would be in heavy demand. He predicted that need and growth, however, are not universally shared.

While the industry as a group is inclined to adopt a highly optimistic attitude on its own growth rate, the airport camp is more to question the validity of FAA's figures, which anticipate the handling of 3.8 million passengers a day at Dulles by 1975.

Four years ago, General Matthew A. Casares, a Baltimore firm which secured selection of the Dulles site to the White House, predicted six million passengers would be handled in 1960 by the combined operations of Washington National Airport and Friendship International Airport, near Baltimore.

The actual figure was 5.4 million in 1960 causing some observers to wonder where the six million passengers to

ports in the industry's traffic growth—the surplus traffic will come from to support Dulles.

Both the airlines and the City of Baltimore feel the FAA Administrator N. E. Halsey, aided by the CAB, applied the answer to that question.

Baltimore has reacted by offering to reduce its general aviation fees and rental rates "if the airlines let us keep the traffic" and by starting an economic development study to prove that Friendship Airport is more convenient for Washington industry leaving in the northern section of the city.

Friendship first has about 1475 acres per 1,000 lb gross landing weight and about \$4.50 for each square foot of net aircraft storage space. Members of the airport board have not regulated past how much they would absorb these costs, and to date some of the airport has made a commitment to the city.

Three local studies made by Friendship officials from a centrally located point in downtown Washington, each cite an advantage of about 15 min for passengers driving the 32 mi to Friendship airport, as compared with the 27-min journey to Dulles, they said. The studies are based on present conditions and actual traffic estimates.

Despite the prospects of losing a high percentage of its business to another airport, Friendship is optimistic over its future, as evidenced by a request it has made to the city for \$15.5 million to expand the airport through 1968. More than \$9 million of that sum, which the airport board notes would not be needed until 1965, would be committed for a new runway.

Airport fees costs are at vital centers in the industry, which has seen this expense rise from \$51 million in operating revenues of \$1.4 billion in 1957, to an estimated \$67 million in revenues of only \$1.9 billion last year.

The question of whether or not these rates are just a matter of more concern between the industry and FAA but they can be judged in comparison with other large terminals such as New York's Idlewild Airport and Chicago's O'Hare Field.

Mileage charges 35 cents per 1,000 lb of maximum gross aircraft weight, as compared with the same rate which FAA could apply at Dulles on a landing weight formula.

Theoretically, this could mean that a Boeing 747-120, bound for Los Angeles at an average gross weight of 270,000 lb, would pay \$32.90 for its Idlewild departure.

The same aircraft landing at Dulles after having consumed about 25,000 lb of fuel enroute from Los Angeles, would pay a base landing fee of \$11. However, the cost of mobile lounge service would bring this bill to \$67.00 if one were used and \$56.40 for two.

Applying the fee in effect last year at Los Angeles International Airport, the same aircraft would pay about \$17 on the basis of a fee of 10 cents per 1,000 lb of maximum gross landing weight.

At O'Hare, the airlines are in a unique position so that they have underwritten a \$150 million bond near the airport, under terms which stipulate that all airport revenues will be used only for interest of the bond itself.

As a result, the airline's landing fees have been placed on a sliding scale based on the predicted traffic volume over a six-month period. This rate has been as high as \$1.25 per 1,000 lb in 1955 and as low as seven cents in 1960. Rates charged last year ranged from a low of 10 cents to a high of 58 cents. Current rates currently range about \$0.50 per square foot a visit at O'Hare, which last year handled 9.6 million passengers.

Many of the airlines have entered the Dulles project as a costly architectural "showpiece," yet a few predict to be the first practical and economical method of handling high capacity to the port airport.

Total costs, including the access highway to Dulles, are now estimated at \$106.8 million, without the revenues allocated airline lounges, and the figure may exceed \$200 million in the future. The Los Angeles airport is at a study at the \$165 million mark, which O'Hare is at the \$150 million mark and plans to continue its expansion to reach a total cost of about \$150 million.

Decks of the Dulles terminal are usually complete, because of the mobile lounge concept, resulting in a saving of waiting stations for the passengers and aircraft turning expense to the airlines. At Los Angeles it is estimated that passengers must wait more than 1,200 ft to complete at one of the finger extensions. At O'Hare the distance stretches to as much as 4,800 ft in the case of transfer from one center to another. FAA feels that whatever fee it charges for mobile lounge use will be offset by airline savings in turn costs estimated at \$25 a minute for turnouts and \$2 a minute for turn-around plane service.

Supporters of the Dulles project also point out that airlines have had to in-



CONTROL TOWER is located at end of 200 ft finger serving center. Turn ramp positions. Public restaurant will be at base of tower. Elevator will give access to top.



Domestic pride of AeroShell Oil W mobility. Rocker box version (left) run for 100 hours using a good straight mineral oil. Rocker box (right) run over 1000 hours in AeroShell Oil W. Note remarkable cleanliness.

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Less oil consumption. Longer intervals between engine overhauls. Easier starting, faster warm-up, reduced wear on piston rings, cylinder bores, cam lobes, lifter faces, gears and bushings.

All these benefits have been obtained with new AeroShell® Oil W. Here, in handy question-answer form, are the facts.

1. What types of aircraft can use AeroShell Oil W? Piston Engine planes of any size, Helicopters, etc.

2. Why is it called a non-ash dispersant oil? Because it contains special additives that help keep any ingested particles in the oil from clumping together and forming deposits. These particles remain suspended and dispersed until they burn.

3. How does this direct engine performance? It means that engine parts stay cleaner. That lubrication points get all the oil they need. Your engine runs more efficiently, parts last longer.

4. What about oil consumption? Because AeroShell Oil W means decreased wear and a cleaner engine, you can expect less oil consumption.

5. Can AeroShell Oil W reduce my maintenance costs? If you have been

using a single mineral oil, AeroShell Oil W can reduce your maintenance costs substantially. Because your engine runs cleaner and cooler, Oil consumption is less. Thus, you can extend intervals between engine overhauls.

6. How does this new oil respond from a cold start? AeroShell Oil W has an unusually high viscosity index. This guards against excessive thickening of the oil when cold, you provide outstanding lubrication when hot. Results: easier starting, faster warm-up.

7. Is AeroShell Oil W thoroughly proved? Thoroughly. It's had test runs of engine hours of flight time.

8. Can I add AeroShell Oil W to a make-up oil? Yes. It is compatible with all piston engine oils now being used.

9. Is there more than one viscosity grade? What do I ask for? AeroShell Oil W is available in three viscosity grades: 80 grade for small engines where straight mineral oil grade 55, 45, or 30 is usually recommended. Also in 100 and 130 grades for large engines where straight mineral oil grade 100 or 130 is normally recommended.

Special note: AeroShell Oil W has been used in aircraft engines for so many millions of engine hours we've actually lost count. Shell Research developed AeroShell Oil W years ago for ahead of competitors. Thus a random example why leaders in aviation rely on Shell.

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vent heavily in their own separate terminal buildings at each point in Idlewild.

Beyond these problems of negotiation, FAA has even more impressive hurdles as each agency is responsible for the ownership and maintenance of the leased-access highway designed to carry 44,000 cars a day by 1975.

To build ground-level links to and from Dulles to a runway, FAA wants to keep the highway for the sole use of airline passengers, and to cover the needs of local Virginia residents the agency suggested enough right-of-way to permit the building of a parallel road system. The State of Virginia has not indicated whether it would accept the offer of the land from FAA or go to the expense of constructing a parallel road for local use.

The agency has also agreed to transfer the ownership of the access highway to the U.S. National Park Service, on the premise that NPS would retain it as a land-use facility, control any development on its edges and assume the usual cost of maintenance.

No previous formal acceptance of either of these offers has been reported and FAA is now busy looking off in another direction that the highway be designated a toll road, as suggested last year by Sen. Andrew P. Schriener (R. Ky.).

Legislation Submitted

Meanwhile, the agency has again submitted legislation to Congress asking for the creation of a National Capital Airports Commission, which would have Washington, respectively, the bulk Washington National and Dulles, under FAA guidance. All revenues collected by the NCAC would be placed in a special fund for the specific use of the two airports. Part of the opposition's authority would authorize it to conduct the road to be any state or federal agency under mutually acceptable terms.

In the case of almost nine state airport control, there are already signs that counties surrounding the airport are likely land FAA's plan to provide street control over zoning and continue race into the airport.

To minimize the noise levels, Dulles County and Department of the Air will require flight over the built-up population with wind speed above 10 knots to 1,100 ft. before proceeding on a scheduled route. Landing aircraft will be required to enter the airport traffic area at an altitude of at least 1,500 ft. and to maintain this altitude for as long as possible before landing.

However, it appears the commercial attraction of Dulles and the proposed Potomac interceptors may lead for the airport is proving an unattractive situation for residential and commercial buildings.

London County, after much deliber-

Turbine Powered Aircraft 1961 Operating Expense

COYTS PER AVAILABLE TON MILE

Type	Flying Operations	Direct Maintenance	Depreciation & Rentals	Total Direct Expense
707	3.36	2.05	3.46	10.11
DC-8	4.42	2.30	3.11	11.46
720	4.30	2.10	3.02	11.81
800	7.77	4.17	4.58	16.52
CARAVELLE	9.81	2.19	7.89	19.87
CL-44	4.81	3.43	4.65	12.89
ARROYO	5.81	3.33	3.55	12.68
ILACRIS	7.05	4.36	5.00	16.41
VIGORANT	10.67	4.62	10.09	25.38
ISLAND COMBAT	11.33	4.42	12.27	28.02
F-27	12.30	8.45	3.89	34.64

ation with its planning commission, has given permission for the total construction to begin on a 4,000-acre community that would be 1,500 acres located about three miles southeast of the airport property. The developers have noted that the community will temporarily be served by an open sewer system until connections are made with the airport's Potomac interceptors line.

Finally, County's planning commission has deferred action on an expensive list of zoning applications until it can study the effect of the Dulles operation on the nearby area. The largest of these applications, for a 52-acre shopping center bordering the southern boundary of the airport, has been deferred for one year. Action has also been deferred on a 75-acre residential zone planned for the adjacent area and a two-story apartment development covering 55 acres.

However, spokesmen for the commission point out that their definitions of these applications are, he considers that by the applicants requesting a special hearing before the County Board of Supervisors.

Traffic Control

While the growth of surrounding communities can cause some future problems, FAA feels the airport is ideally located for air traffic control purposes.

In 27 mi. distance from Washington, the airport traffic pattern from any direction to the built-up town and associated patterns serving both Washington, National and Potomac Traffic Area will be further expanded by an airport reservation extending 18 mi. to either side of the airport runway. It is also anticipated that FAA will adopt a "multiple" system for all Washington traffic providing a common holding point for all arriving aircraft and with approach control by a single traffic control.

Reporting to Congress on the status

of the Dulles project, the Comptroller General's office recently noted FAA's adoption of the mobile lounge concept, the type of terminal building, and a series of design changes in the building after construction was under way for the increased cost of the project and its many delays.

Data Disputed

The report questioned these items:

- Disagreement between FAA and the engineering firm of Ammann & Whitney over details of the final design for the terminal building, actual construction planning reviews and a work stoppage that delayed completion of the structure by some three months.
- Estimated 80 months was lost in the grading phase of construction because of weather and delays in supplying final grading and drainage plans for the terminal area. In a 10-month period, the contractor submitted plans totaling \$2.5 million to cover the cost of increased labor, the loss of heavy equipment and the cost of storage of equipment on-site. As of February, the claims were valued for \$1.1 million, the report stated.
- Since inflation caused the report project contractor to claim totaling \$1.2 million for increased labor costs and the loss of use of rental of construction equipment over a one-month period. FAA later verified this claim and some modification by the same contractor for \$1.1 million.
- Terminal building costs increased \$5.7 million primarily because of a \$1.5 million added cost to design the structure for vehicle loads, increased the price by \$1.4 million and brought total claims from the contractor amounting to \$172,000. The agency later settled these claims for \$465,000.



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Airlines Predict Puerto Rico Traffic Surge

By Gloria Garrison

New York—Curtis' increased yet unexpected and independent use of the "air bar" principle of service highlighted airline activity this year in the growing Puerto Rico market.

Airlines are predicting big increases in traffic to Puerto Rico this year. Both as a tourist attraction in itself and as a gateway to other Caribbean ports, the island has been increasing its importance, and already is drawing off more of the business from Miami. Tourism has been limited by lagging hotel space, but new projects are under way and an increase of 2,000 hotel rooms is scheduled during 1962-63.

Backbone of the Puerto Rico business for the airlines has been the New York-San Juan run with its heaviest market of Puerto Ricans who return back and forth in large numbers as seasonal agricultural workers, often relocate to the New York area, and frequently visit relatives at either end of the line. But this is a relatively stable market alone, and future growth in the market is expected from both tourism and business travel in connection with the island's "boomtown" economic development. Jet service to Puerto Rico last year was dominated by Pan American, which was offset to the island by Jet Blue. Now, however, Eastern is coming as strong with jets, will increase its New York-San Juan jet flights from two to five daily under the new schedule effective next month. Trans Caribbean Airways, the other New York-Puerto Rico operator, placed its single Douglas DC-8 air service last December, will add a second jet by late June or early July.

Eastern also is seeking to open up new business in the Midwest with jet service to Puerto Rico from Chicago, Detroit, Cleveland and Pittsburgh.

Delta Air Lines plans to inaugurate through-jet service between Los Angeles and San Juan via New Orleans next month. The Convair 440 service means four times weekly.

The "air bar" service, which is called by various names by the different airlines, is a principle similar to the service Eastern inaugurated in 1960 to Florida from the Midwest and has been expanded. It is a service system in which the passenger's ticket is his transportation. Refunds are granted only if the ticket is forfeited 14 or before departure time.

However, in the Puerto Rico service, the requirements have been modified. Now, if the passenger shows up at the airport within two hours after scheduled departure, his ticket will be

issued on the next tender flight in which space is available. This change lowered complaints of hardship situations involving Puerto Ricans.

The "air bar" principle of the air bar service tends to be particularly valuable to the airlines in this market, where demand for space is high and the no-show problem was particularly severe because of language and other difficulties of the cross-country group which made up so much of the traffic. There has been considerable resistance to the new system by Puerto Ricans, and Civil Aeronautics Board now is investigating the matter. Eastern calls the service bus, Pan American calls it theft, and Trans Caribbean calls it tourist. In each case the New York-San Juan jet ran at \$57.75 one way.

The regular tourist fare of \$76.10 one way largely has been replaced by the air bar or theft fare, reducing the Puerto Rico service potentially to two classes of service. Between New York and San Juan, Eastern's first class (\$116.65) and its business accommodations on every flight. PanAm has only one named flight a day, often one of three. Trans Caribbean offers two classes on each flight, the low fare, and what it calls the low tourist, at the regular tourist rate.

Scheduled airlines between New York and San Juan now are subject, and expected this year will climb sharply. PanAm's regular flights to San Juan between the two points start month, up from 40,000 during the same month of last year. By July, PanAm's capacity will total 75,234 seats in high density for the month, and including extra services. With its second jet, Trans Caribbean in July will offer 8,000 seats a week, up from 3,000 last July in its DC-8s. Eastern will offer 7,811 seats a week between San Juan and all other points next month, up from 15,233 last May, and by July the total will increase to 20,234 seats.

Last year, PanAm earned 99,968 passengers in and out of San Juan International Airport, including a small percentage of transient passengers. Fig. units include traffic to and from Miami, Baltimore and Caribbean ports as well as New York. Eastern's annual figure for the year was 380,000 passengers, and Trans Caribbean's was 111,171. The responsible total of 392,232 was achieved by Caribbean Atlantic Airways in its operation between San Juan and the Virgin Islands and between San Juan and inter-Puerto Rico ports.

Eastern's loadings of 100,945 last year at San Juan, however, are expected to increase to 125,000 in 1962. PanAm predicts a 90-95% traffic increase be-

tween New York and San Juan, and Trans Caribbean's estimate is about the same.

A survey of passengers who traveled by air between Puerto Rico and the U.S. in April 1960-61 indicated that 286,206 of the 511,000 departing passengers were residents of Puerto Rico. Of these departures, 59% left for New York. About 90% of the trips was to report for work or to seek work (25.5%). Visiting relatives or friends, establishing residence, and accompanying relatives were other reasons. Of the total, 17,455 were bona fide tourists.

Of the non-tourist departing passengers, tourists accounted for 29.7%, baggage percentage—37%—left to visit relatives or friends.

The three airlines in the New York-San Juan service have filed for group fares, aimed primarily at the movement of Puerto Ricans. There are four classes of groups in varying fares: 30-74 persons, 75-99 persons, 100-124 persons, and 125 or more.

From the U.S., in addition to New York and the midwestern cities, San Juan is served from Miami by PanAm and Eastern, from Boston direct by PanAm and via Philadelphia by Eastern from Philadelphia via Baltimore by PanAm and from Newark via Baltimore by Eastern.

Aircraft Paint Urged As Safety Measure

Washington—"Some paint on the exterior surfaces of an aircraft is necessary, better than no paint" but not specify purposes, according to a study completed for Federal Aviation Agency by Applied Psychology Corp.

Experiments with paint patterns are most helpful to pilots at ranges of less than 4 mi., according to the company's 64-page report, which is entitled "The Role of Paint in Mid Air Collision Prevention." The patterns should be standardized and either fluorescent paint on the orange and red portions of the spectrum, it said.

However, the study warned that currently available fluorescent paints are expensive to apply and maintain and not too durable. A motorcycle was questioned that all aircraft be painted to enhance their conspicuity, it said. "Apparent inappropriate visual technology and color schemes and cost reduction are advised."

Applied Psychology had recommended that FAA encourage use of fluorescent paint, but at the option of the aircraft owner.



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The new S-64 Sikorsky Skycrane, now in test, is a heavy-duty helicopter capable of lifting an astonishing variety of 9-ton loads of almost any shape.

Powered by two 4,056 hp Pratt & Whitney Aircraft JPTD-12 turbine engines, the Skycrane can hoist men and materials over marsh and mountain at 145 knots, or hover overhead to load ships and erect steel. It can string wire, lay pipe, tow boats, truck submarines, position mounds, and lift everything from letters to logs. Fitted with interchangeable

pods, the S-64 is a 60-man troop transport, vehicle carrier, supply ship for limited warfare, or mobile you-erase-it. In fact, the Skycrane is so versatile its uses are limited chiefly by man's imagination.

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SHORTLINES

► **Allegheny Airlines** made a net profit of \$7,411 in March compared with a net loss of \$196,898 in March, 1961. Net loss for the first quarter 1962 was reduced to \$101,019 from a \$294,795 first quarter 1961 loss.

► **Bonair Airways** has placed in operation a completely automatic communications system linking its Latin American communications with its North American teletype system. The system will link more than 100 offices in the two continents.

► **Delta Air Lines** will begin rampstop service between San Francisco and Los Angeles June 1 with DC-8 jet aircraft. The restriction in the Southern Team contractual Service Class prohibiting rampstop passenger service was removed April 23.

► **Eastern Air Lines** will cut its "no show" rates on domestic Airbus flights May 15 if Civil Aeronautics Board approves. The new rule would penalize a passenger holding a confirmed Airbus reservation, but who misses his flight, to board the next Air Bus flight as a space-available basis if he reports in an Eastern ticket office within two hours after his original flight departs.

► **Pacific Air Lines** reports a net profit for 1961 of \$517,125 after taxes, compared with a net loss of \$226,795 after taxes in 1960. Pacific attributes the turning to schedule savings and strict cost control.

► **Passenger revenue** continues to rise during the first quarter of 1962 compared 1961 over the same period last year. First quarter 1962 domestic passenger miles totaled 64.3 million.

► **San Francisco & Oakland Helicopter Airlines** has leased a third 10-passenger turbine-powered Sikorsky S-62 and added flights to Spanish Helicopters in the Mexican coastal Pacific Center, San Jose del Cabo. The airline expects to negotiate purchase of the three S-62s and a 20-passenger twin-turbine Sikorsky S-61B by December.

► **United Air Lines** had a net loss of \$5.00 million for the first quarter of 1962. The loss for the same period last year was \$744,800. United attributes much of the loss to bad weather forcing it to cancel 10% of its scheduled mid-day during the first quarter.

AIRLINE OBSERVER

► **White House** is expected to be the biggest airline merger yet—the proposed union of Pan American World Airways and Trans World Airlines. Merger is well beyond the talking stage and terms of stock exchange have been agreed upon. Toppled into the merger have been other airlines because of the widespread impact passenger merger will have on both domestic and international sides of the industry. Even with White House approval, the plan would face a stormy reception, and give the Civil Aeronautics Board its worst battle, probably yet in the merger would change the entire complexion of the U.S. airline industry and would require a complete overhaul of U.S. international and aviation policy.

► **Watch for an early move** by Kennedy Administration to expand U.S. civil air routes in Africa. Action will be prompted primarily by continuing Soviet interest in African airline operations.

► **Independent Airlines Assn.**, representing supplemental carriers, has filed in a U.S. court for an "injunction" under Chapter 11 of the Bankruptcy Act. Association has been hit by recent Defense Department order for pending inflating operations of member carriers throughout the world and withdrawal of eight of its members who own the organization substantial share of assets.

► **Airline common stocks** were hit hard last week by a steadily declining market. Mop-ups of listings on the New York Stock Exchange seek to new loss with late Western Air Lines showing any resistance to the slide-off.

► **Aircraft plans** to triple turnover from per man-hour of work by the 1958-1970 period and to increase labor productivity in air transportation "in more than five times" between 1960 and 1980. The Russian estimate that in 20 years air labor productivity will be "several times higher" than in U.S. air transportation.

► **Mobarak Airlines**, in its annual report, cites "lack of regulatory direction" by federal agencies as its "most serious language problem." The carrier charges that agencies apparently expect liability reduction will be achieved by managerial effort, since no federal agency applies comparable pressure to states labor to curb excessive wage and fringe benefit demands. The report also charged that major cuts were created by mandatory regulations of the Federal Aviation Agency imposed without due consideration given to the economic impact of such orders.

► **Continental Air Lines** is changing emeraldgreen to its 11 Vickers Viscount 600 turboprop transports from eight coach and 44 first-class seats to 25 coach and 32 first class.

► **Air Mail** will begin regularly scheduled service between Havana, capital of the Republic of Cuba and Moscow. Service will be provided by Russian-built Tupolev Tu-154s flown by Soviet airlines. Air Mail personnel. Czechoslovakian pilots and technicians are also working for the Airline carrier which uses Russian international from Havana to Rostov, Moscow, Minsk and Paris, Accra, Ghana, Conakry, Guinea, and Abidjan, Ivory Coast.

► **Mandatory passport** measures for all international passengers on flights originating or terminating in the U.S. is gaining strong support. CAAs in studying feasibility of legislation measure current to provide coverage up to \$10,000 per passenger, and Sen. Homer E. Capehart (R-Ind.) plan to introduce a bill in the next session of Congress ending the mandatory requirement. Meanwhile, Intelligence Group on International Aviation will submit its recommendations to the State Department within the next 30 days as to whether the U.S. should withdraw from Warsaw Convention and with or without to sign the Hague Protocol (AW [Int.] p. 35).



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Pressure on Southern Pledged by Candidate

Washington—Capt. John C. Carrill, who sells the proficiency of Air Line Pilot, Inc., has promised that if elected he will urge AFL-CIO to remove its deposits from any bank extending credit to Southern Airways.

Tearing the 25-year old pilot aside against Southern ALPA's "most serious and pressing problem," the Tulsa World Airlines captain said he would urge AFL-CIO members to close doing business with all companies supporting Southern's 4th product.

In a letter to all local branches of the union—normal of a union that will deliver his platform—Carrill also urged that the members of all union-represented banks boycott the financial houses that handle Southern Airways stock and debenture sales.

Underlying theme of the Carrill platform is that ALPA efforts to end the Southern strike in a union-approved manner have lacked purpose and force. "There is not an iota of," he said, at the union industry, but "we have even begun to fight the war."

ALPA channels of doing business are "unusable, ineffective" only when dealing with problems peculiar to an individual airline, as a particular group of pilots. But recent ALPA history, Carrill said, shows that as matters of concern to the entire membership, pilots have been unable to act decisively.

For this reason, Carrill recommended a thorough overhaul of the union's structure and a realignment of administrative responsibility within it. Carrill currently ALPA's first vice president and national training officer, promised to explain these recommendations in detail in a subsequent letter.

FAA Project Checks Accuracy of Doppler

Washington—Precision accuracy of an airborne Doppler navigation radar is being checked by two Coast Guard ocean strikers which performed beachcombing searches in the North Atlantic in part of Federal Aviation Agency's Project Accordion.

Jet transports equipped with Doppler-derived alt of which are operated by Trans World Airlines will compare their trace over the target area with the radar signals recorded by the aircraft ship. Consequently, technicians on board the two ships will ensure the beams do not move by actual sight rays.

Accordian's aim, according to FAA, is to determine just how well aircraft operating along their transatlantic routes can pinpoint their position.

SCIENTISTS AND ENGINEERS:

Today the men of Motorola's aerospace team are applying creative intelligence to the study, design, construction and test of advanced space communications command and control systems. Vital contributions are being made to such important current NASA programs as the Goldstone air-base Range and Range Data Tracking System... the JPL Mariner and Ranger astronomical planetary and lunar probes... and updating of the Deep Space Instrumentation Facilities to "B-band" for JPL. If you are interested in shaping the future with a dynamic aerospace contractor as these and other programs, we can offer immediate opportunities to both System and Equipment Design Engineers. Write us today describing in detail your experience in the following areas of aerospace technology:

System Design • communications, telemetry, command and control, radio tracking, data handling, detection and correlation.

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SPACE TECHNOLOGY



Rauscher stands beside Ames Research Center laboratory model of Apollo capsule wearing disintegrator suit.

NASA Studies Apollo Cockpit Instrument Layout

Technicians adjust helmet for crewman during cockpit layout and development studies. Right, crewman uses a reception tented during a simulated mission as part of program to establish positions of key instruments.



Three men crew prepare to enter Apollo cockpit drawn at actual rate developed at National Aeronautics and Space Administration's Ames Research Center (AMC July 1, p. 17). Standing is 11 ft. in diameter, 12 ft. high and is of aluminum construction. Below, two crew enter, in full pressure suit, left and shoulder harness suit, right, go through instrument check in the Apollo cockpit. Fusion and design of dials and switches will be developed in the workshop of the Apollo capsule.



Now the Bell System integrates switching and transmission in a new digital communications system

Right now transmission and switching of communications are separate functions. They are usually performed by space-divided processes.

However, the development by Bell Telephone Laboratories of an experimental high-speed electronic model called ESSEX (for Experimental Solid State EXchange) may change all of this. And it may revolutionize military as well as civilian communications systems.

ESSEX works on a time-division principle. For the first time, it integrates both transmission and switching.



Above is an overhead view of the ESSEX (Experimental Solid State EXchange) research model set up at Bell Laboratories. Only behind the control console are only half of the total equipment.



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Faster, more efficient service

By harnessing time, ESSEX may introduce the following revolutions in communications:

More messages can be transmitted on fewer lines. Through the use of Pulse-Code Modulation (PCM), signals are converted into coded, digital pulses. These pulses are carried at high speeds to their destinations on just a few lines and are then reconverted to standard signals for delivery.

Central office switching networks can be much smaller. The PCM conversion is done at special "concentrators" close to a number of customers. Today every telephone is connected to a central office by two wires. By consolidating many signals on a few lines, the "concentrators" will allow central office switching networks to be much more compact.

Promising Development

Although full-scale use of ESSEX is still in the future, it shows how Bell System developments arising out of basic research can permeate into extraordinary communications advances.

ESSEX becomes practical through Bell Laboratories' discovery of the transistor and development work with semiconductor devices. What ESSEX will lead to—in both military and civilian communications—only the future can tell.

This is another example of the Bell System's continuing efforts to improve communications techniques and services.



P-1 Solid Fuel Rocket Develops 125,000 lb. Thrust

P-1 solid fuel rocket motor built by United Technologies Corp. at Morgan Hill, Calif., under an Air Force research contract (AW Apr. 25, p. 19) developed more than 125,000 lb. of thrust in tests. The motor will be used by the Titan 3 boost vehicle. Insulated glowing in sight of smoke caused rocket engine to burn for 100 sec. Tests were repeated successfully. In tests, the motor was used to fire a liquid to induce hypergolic ignition with the solid propellant. P-1 motor contained about 50 tons of propellant, had a burning time of approximately 150 sec. and incorporated the bottom center support and endcap shroud of the P-12 motor fired previously for about 50 sec. (AW Dec. 16, p. 10), accumulating a total of 225 sec. of motor burning. P-1, designed for 150,000 lb. thrust for 60 sec. burning time, developed average of 125,000 lb. thrust in 155 sec. firing.

Increased Comsat Profit Margin Urged

By George Alexander

New York—Profit margin on a communications satellite service should be higher than on present ground-based systems, a committee report sponsored by the Federal Communications Commission for companies to undertake such a program and in conjunction of the radio communications launched in development of a satellite system.

Theodore F. Reagin, vice president and general counsel of the General Telephone and Electronics Corp., speaking before a Space Law and Security conference of the American Rocket Society here, said that a fair return on a communications satellite would be about 16 1/2% on revenues plus interest and 10% on total capital investment. Reagin said that regulated utilities are allowed by law to make as much as 10% return and that, when the enormous scale and risk of a communications satellite are taken into consideration, a higher return should be allowed, a slightly higher return for their enterprise.

Reagin repeated the idea of government ownership of a communications satellite enterprise, as urged by some U.S. senators (AW Mar. 24, p. 27) on the grounds that private enterprise could do a better job than the government. The fear that federal regulation would be insufficient to protect the public interest against domination by a single carrier, he said, argued more for better legislation than for federal control of the satellite service.

The General Telephone Service also said that all-weather ownership was preferable to the present compromise plan of 50% ownership by carrier and 50% by the general public (AW Apr. 2, p. 38) because there can be a long period of loss, as the system develops before profits begin to appear. He said that universal service would be unlikely to afford prolonged losses and that only financially strong companies would be able to cope with the ups and downs of the nation's development.

Paul John Cobb Cooper told the conference that there must be international agreement on the meaning of the term "universal" and "service," as used in the Chicago Convention (1946) on international civil aviation, if the expense of space is to be passed peacefully and legally.

Cooper said that the Chicago Convention did not specify the upper limit of territorial airspace and the consequent extent of national sovereignty. If nations agree that "airspace" is that part of the atmosphere in which conventional winged aircraft can operate, he said, then spacecraft flying above that region would not violate a nation's airspace. If, however, countries maintain that airspace extends up to 40 or 50 mi., where there is at least some power to affect a spacecraft's flight, Cooper said that the international problem becomes "more complex with every new use of outer space."

Cooper suggested two solutions. • Non-competition by the International Civil Aviation Organization (ICAO), which was created by the Chicago Convention, on the basis of airspace. But he noted that the Soviet Union was not a party to the 1944 Convention and would not have to honor the ICAO decision.

• United Nations treaty, negotiated with all member states, to define "airspace" and "aviation." Cooper suggested that such a treaty recognize a nation's absolute sovereignty to control upward

HEAT EXCHANGERS IN A HURRY



(Q: A new slant on $q = U A \Delta T$)

Heat exchanger design problems are expected to make young men gray and older men bald. It then gives us joy to report that Bendix heat transfer engineers are today retaining whatever normal alertness they started with. Yes on a profit theory.

Bendix offers complete design, prototype and production services for plate-fin heat exchangers. We produce these compact, lightweight and highly efficient components by both dip-brazing and epoxy bonding, with aluminum, stainless steel, copper and other materials... in special configurations for missile cooling, intercoolers, air coolers, air conditioning systems and other land, sea, air and space applications.

What's new about that? Just that! To design the best heat exchanger for a given job, a number of complex interrelated thermal variables—heat transfer rate, thermal conductance, transfer area, fluid and cold-side temperatures, etc.—are usually regarded as unrelated. During this labor, the designer must also find a way to satisfy such vital animal requirements as noise, weight, strength, reliability and cost.

We now approach this problem as possible under the circumstances, that Bendix supplies new techniques that enable plate-fin component heat exchangers to be designed and produced faster than ever before.

This is not the result of an overnight inspiration. Our Environmental Control Systems Department has long been busy with a sleek and deep-probing investigation of sim-

ulated approaches to heat exchanger design. This study was possibly abetted by the experience, the know-how of previous operating conditions, and the voluminous test data we've accumulated in over 25 years of designing and producing successful heat exchanger systems, as well as component exchangers and other types of environmental control systems.

Our new design method enables us to fit optimum exchanger relationships and values with surprising speed. In several recent cases, we've designed complex new exchangers in a few hours!

How do we do it? The details we guard. But we can say that design reliability as well as speed is insured by a pre-engineered feedback checking technique. (In a recent test laboratory, we tapped the new method "Feed-back-Cascaded Design.") It may strike other existing technology as contained in our best exchanger bulletin, which we'll naturally send on request. (If you don't already belong to The Bendix Environmental Control and Matching Society, be sure to ask for your membership invitation first.)

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*Thought (could show more data to reader upon request) exchanger design. Actual results may vary. Terms of design, prototype and production are 30 to 45 working days. Minimum order, \$10,000.

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of 20 to 25 mi. altitude where conventional rockets can be sustained in flight, a 500 mi. high zone of heliostatic occupancy with the right of transit as needed to non-military spacecraft of other countries when working in the vicinity of or from its own national territory and, above 300 mi. altitude, a zone of free space flight comparable to the high seas.

Cooper also said that a peace definition of "territory" was equally as important as one for "airspace." The previous treaties of McGill University showed that previous international agreements have considered needs to be mutually capable of forming support from treaties with the air forces of unopposed. Cooper said, the N-17 or Lt. Col. John H. Glenn's Mercury capsule—after its parachute system had been deployed—could be included in that definition.

Since international law contains various provisions against the flight of one state's aircraft over a second state's territory without the latter's permission and authority, Cooper said, an international agreement must be reached on what devices fall within the meaning of "territory" or "the peaceful exploration and use of outer space may be subject to legal complications."

Space Cooperation

Rep. Victor L. Adonis (D-N.Y.), member of the House Committee on Science and Astronautics, made a strong plea before the conference for U.S.-USSR cooperation in space exploration, saying that such cooperation is "no longer desirable, but imperative." The congressman said that he believed the reason the Soviets are pushing for co-operation is a growing realization within the USSR of the very high costs involved in space exploration.

Adonis added that the United States should give serious consideration to cooperation with the Soviets in light of present heavy expenditures and the even greater expenses projected for future space work.

Adonis thought the case of Soviet Premier Nikita Khrushchev's reply to President John F. Kennedy (JAW May 26, p. 25) was "reasonable and free of conditions," although he noted that the Soviet leader tried to tie space cooperation with disarmament. "We should cooperate with the Soviets," Adonis said, "but always taking care of our own interests."

Dr. Margaret Mead, noted anthropologist, also addressed the ARS convention and called for development of a technically precise, idiomatic-free language for space work so that cooperation between various states might be based on a level of clear understanding and not on political propaganda.



DIRECT REACTION PRINTOUT from our G-20 computer provides quick visual interpretation of PERT data by project management. PARE (Program Analysis and Resources Evaluation) is the next step in our development of Bendix in aid management, budget, cost, and engineering skills analysis to computer aids for modern management.



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Since the unit is electric/mechanical, it remains true to its environment—a 30-year storage life without maintenance. It performs after exposure to high "g" forces, while noise and vibration, shock/vibration impairments ranging from -55°C to $+130^{\circ}\text{C}$. Simply plug in the module, it is operational on command.

Designed to simulate missile arm and surface like that shown here, the design principle is equally valid on units ranging from sub-minutaries to multi-ton weapons.

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One thing is clear: this design is a definite advance toward more sophisticated performance through simplicity. It's simply one evidence of the kind of basic thinking the design engineers of American Electronics are applying to a multitude of aerospace problems. American Electronics products are now being reliably with most of the nation's missiles and satellites. AEI's work in aerospace can probably help you, so why not write for a comprehensive brochure on AEI activities. As the same time, request detailed performance and technical data on the actuator.

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Economics of Planetary Travel Analyzed

The following report on the economics of interplanetary travel was written earlier last year by American West & Sons, Three South St. H. H. Koelle, director of the Future Projects Office of National Aeronautics and Space Administration's Group C, Marshall Space Flight Center. The report appeared on the January issue of NASA.

By H. H. Koelle

One of the low elements, at first the determining factor of our progress in the national space flight program, is the availability and capability of launch vehicles. Therefore, let us take a quick look at where we are today and where we are going.

Approval of the Saturn C-3 launch vehicle configuration, and the decision to move ahead as rapidly as possible with a Nova for suborbital launch and a dedicated pattern for what is expected to be the case of ground launch vehicles during the next 10 years. This decade will find us concerned with quickly increasing the payload capability of launch vehicles and, therefore, the national space capabilities. This approach is dictated by competition with the USSR for an early accomplishment of planetary space flight mission objectives and appears to be a sound one for this decade. The question of economic merit will, second in priority.

What, then, do we expect to accomplish during this decade? We should have an operational capability for 10-ton orbital payloads (C-3) by 1967, which will increase to 100 tons (C-5) by 1967, and 200 tons (Nova) in 1969. There is an increase in the order of magnitude over that which we have today. The first research and development flights for these vehicles will begin approximately two years prior to these dates.

Future Aims

Each of these vehicles is a two-stage, expendable rocket to low earth orbits and a three-stage to escape velocities. Its escape mission then reduces itself to carry about 95% of those orbital payloads which chemical stages are used and approximately 75% if nuclear stages are employed. After 10 research and development flights, one can hope for two successful missions out of three attempts, with an expense of about three out of four after ten operational years and out of five in the fourth operational year.

These vehicle sizes, payload capabilities and proposed mission capabilities will produce a specific transportation cost approaching \$1500/lb for direct operating cost (vehicle procurement).

profitable, ground transportation and launch operations) for transporting cargo from the earth surface to low earth orbits over the end of this decade. For many it may well be paid for each year of cargo delivery to the moon, a long or short-term mission as well as a launch. There is little hope that the cost of earth-to-orbit transportation can be improved by introducing a further upper stage during this decade. However, a nuclear stage should make it possible to reach a specific transportation cost of about \$6000/lb for cargo transportation to the moon in the late 1960s.

Translating this rate of the earth-to-moon stage into the cost of passenger transport, we would have a \$300,000 trip fare for earth-to-orbit flights and a \$10 million trip fare for a lunar round trip around 1973. Obviously, we have a long way to go before we can speak of commercial space flight.

There, what are we looking for? We would like to see one of these years, earth-to-orbit trips as commercial and cheap trips to the moon and beyond to the moon as more expensive than a trip around our own planet today. Then and only then will we be able to speak of commercial space travel in the true sense.



H. H. KOELLE

Here, however, Koelle, director of the Future Projects Office at NASA's Group C, Marshall Space Flight Center, Huntsville, Ala., is a graduate of the Institute of Aeronautics, Stuttgart. He holds a bachelor of science and a master of science degree in mechanical engineering. Koelle headed the Science for Nuclear Technology and Space Research in Stuttgart in 1946 and worked at Aeronautics 1945-1953. He is the director of the Space Flight Center is responsible for study, planning and design of advanced space vehicles and space transportation systems. Koelle is the office of the "Headquarters of Astronautics Engineering" (McDonnell-Hall, 1944) He was born in Danzig in 1925.

Translating this into figures, and using present or traffic ability rates, we must average more than 40 successful flights out of 30 from earth to orbit and return, when we can expect that earth-to-orbit passengers can be sent on flight. We must also reduce the specific turn-around time to less than 55% of actual payload to make this economically attractive. For these figures with cost parallel flight rates, approximately 10 out of 25 must be successful with 10 passengers per flight.

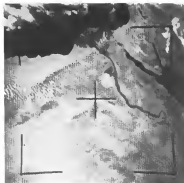
The specific payload cost for each a trip to the moon must be reduced to less than \$25/lb, or even less, to make commercial flight. Unfortunately, we do not have a reliable concept for reducing this rate of the cost and, therefore, it may be 1980 or later before we can expect to open the first commercial space line and to the moon. The only hope for an earlier date is the possibility of a breakthrough.

While we are waiting for this breakthrough, however, we will support the state of the art beyond our present mission and Nova launch concepts and around 1970, we can expect to improve the specific transportation cost for orbital and lunar trips by, perhaps, a factor of five. That can be expected to be within the state of the art by the year 1975 to 1980. This is what we think we can do and what we will consider as "future projects" on the coming years.

Rocketless Concept

The key to economical earth-to-orbit transportation must be the reusable vehicle. Essentially we must abandon the concept of expendable vehicles which is only a very good shortcut to a rapid increase in payload capability. We must design a vehicle which can be turned at least 100 times and, for passenger comfort, does not exceed more than 3g in a standard ascent or descent trajectory. This means we must accept a concept similar to the rocket airplane. We also should try to approach the operational concept of jet planes to make space travel attractive and acceptable to the average passenger. It appears unlikely to develop two-stage rocket airplanes for earth-to-orbit traffic. A vehicle in the C-5 class (for example, the space shuttle program) would offer a payload capacity of 100,000 to 150,000 lb. The weight of the system on the ground as a payload subtracted of approximately 100,000 lb as compared to the present expendable C-5 with a 200,000 to 350,000 lb payload capability.

Later we might find ways and means to take advantage of the oxygen in the air, making it a single-stage earth-to-



Tiros 4 Photographs Holy Land, U.S.

Photograph taken by Tiros 4 weather satellite shows Egypt, Saudi, the State of Nevada, the Red Sea, the Nile River, the Mediterranean and the Dead Sea (above). The NASA satellite was in its 980-km orbit and was at about 690-mi. altitude. Below is Tiros photograph of Great Lakes seen on its 980-mi. orbit.



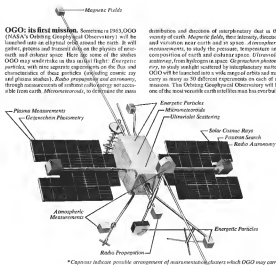
orbit aerospace plane. However, this approach appears to be attractive only if it does not require a much more complex engine system. The present launch operations concept should also be reviewed to use it there as a way to reduce the initial high risk of vertical takeoff for personnel-carrying vehicles and, at the same time, reduce the tremendous cost of orbital shuttles and launch facilities. There is no conclusive evidence, at this time, that horizontal takeoff with some assistance on the ground, is not feasible. Admittedly, it gets some of the burden on the firing facilities, but it could be that improved propulsion systems may make this acceptable.

We cannot hope to introduce space flight to the general public unless we find an operational mode and operational cost acceptable to the "high-income taxpayer." If we are successful in developing a single- or two-stage chemical rocket aerospace plane and learn to fly at 160 times or more before it is more one, we should be able to achieve a specific transportation cost to earth orbit of about \$10/ft. or less. It is also obvious that the trend toward the reusable vehicle concept does lie in the liquid rocket system rather than the solid propellant system. While the solid rockets might offer an alternate method to gas large payloads first they do not seem competitive with the reusable liquid vehicle in the long run. This is obvious when one considers the fact that solid propellant cost one dollar per pound and liquid propellant two to five cents a pound or, for high energy liquids up to 25 cents a pound. Propellant cost becomes a dominant factor for reusable vehicles with high maneuver rates.

Reusable Vehicles

The true basic concept of reusable vehicles appears to be feasible and attractive for advanced linear transportation systems. Such systems would make use of a chemical reusable rocket aerospace plane to orbit, a reusable nuclear gas turbine craft to take orbit and back, and a local chemical (brake stage) linear shuttle carrying cargo and personnel between the lunar orbit and lunar surface. The nuclear ferry vehicle would be refueled in earth orbit and the lunar shuttle in lunar orbit. Preliminary investigations show that lunar round-trip costs can be reduced to about \$1 million/ton using such a system.

If and when we learn to manufacture propellants on the surface of the moon, this system can be further improved to a point when one round trip costs less than \$1 million/ton. The alternate method of developing an economic earth-linear transportation system is the all-rocket rocket. However, we must find a way which offers specific impulses considerably better than the



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DAGE RGS-10... 'WATCHDOG' FOR THE ATLAS MISSILE

Television has assumed a variety of important roles in military communications; perhaps none is as needed as in the activation of missile sites. For Athena's Atlas defense complex, Dage RGS-10 television systems will soon be at every operational Atlas base across the nation. They will be needed for observation of fueling and test firing, surveillance and other key operations. The systems must perform under the most rugged environmental conditions possible for TV equipment. Why was the Dage RGS-10 system picked for this critical application?

Recently, the Air Force and the Astronautics Division of General Dynamics performed a series of tests on several closed circuit TV systems to determine which could take the constant punishment encountered in Atlas Systems support—and still produce sharp, clear pictures. The Dage RGS-10 was the system that met all the following requirements:

- Shock (MIL-S-5570B Proc. II) and Vibration (MIL-S-5570B Proc. II) Among other things, these two tests must prove that the camera can "take it" while directly mounted on a rocket or its missile.
- Explosion Proof (MIL-S-5570B Proc. II) Certified that the camera can contain an internal explosion of 100/100 cubic avoirdupois gallons.

- Satisfactory operation at light levels of less than one foot candle
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- Certified operation under noise levels of 150 db ... permits direct, clear range observation of rocket blasts.
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Here are a few other applications of Dage television systems:

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Sunlight tracking	Rescue observation
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Point Arguello—California	Fort Belvoir—Vermont
Rocket engine test observation	Anti-airborne runway observation
Red Stone Arsenal—Alabama	Commo Naval Air Station—California

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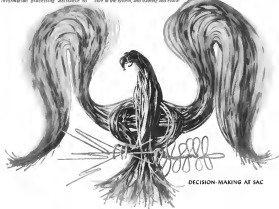
decision-makers. It has created a number of new positions at System Development Corporation. SDC has helped create that new science/technology, beginning with SACs, the last major system for decision and control. Today, its scientists, engineers and computer programmers are at work on the SAC Control System. They are also contributing to a number of other command and control systems now in their early stages. They participate in the key phases of system development: analyzing system requirements, synthesizing the system, instructing computers which are the core of the system, and testing and eval-

uating the system. Herman Fenton, Scientific Operations Research Scientist, Engineers and Computer Programmers interested in joining this new science/technology are invited to write Dr. M. L. Rost, SDC, 2452 Colorado Ave., Santa Monica, California. Parsons are open at SDC facilities in Santa Monica, Washington, D.C., Longmont, Colo., Fairfax, Va. "An equal opportunity employer."

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DECISION-MAKING AT SAC

500 to 1,000 sec, which is now being discussed and is in the early development stage. It is very hard to see when we might be able to do this, but that might be the breakthrough mentioned earlier in this discussion. It is a quiet fact, therefore, that we will proceed with the development of an all-weather three-phase earth-least transportation system, of course, we find a better way of doing it. The first portion of such a system would be a reusable chemical rocket airplane plane from the earth surface to orbit and return.

Up to this point in the development of space systems, it has been quite difficult to sell the idea of reusable vehicles because it can be easily shown that (1) these systems are fairly expensive to develop and (2) the development will take several years. This reusable system will be acceptable only if it can be shown that there will be a real market for space travel. Recent studies indicate that space flight can become cheap enough to be the foundation for the development of a large market. From the economic viewpoint, it is probable that, if enough space research develops, the market will increase rapidly during the 1970s. That chance is good that the next space vehicles, following the present family of expendable launch vehicles, will be reusable. Therefore, besides trying to beat someone else to the moon, let's get on with the job, design such vehicles, find the best design and operational concept, optimize the system to make it attractive for all potential users and show the country what it needs, not only to attain but also to sustain "space superiority" in the 1970s. If we do not do that, we may "win the battle but lose the war."

U. S., USSR May Exchange Weather Satellite Data

Washington—Four U. S.-Soviet proposals to form a global weather watch system based on meteorological satellites and a chain of regional, multi-national forecasting centers will be submitted to the World Meteorological Organization on May 22.

Drafted some weeks ago in Geneva by Dr. Harry Wexler, U. S. Weather Bureau director of research, and Viktor A. Bages, assistant director of the Soviet Union's Hydrometeorological Service, the proposal probably will involve:

- Coordinating the orbits of meteorological satellites launched by the U. S. and the USSR to obtain maximum coverage of the earth's surface.
- Standardizing the manner in which data thus collected is analyzed and disseminated through regional forecasting centers.
- Pooling of resources by underdeveloped countries to make possible the

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Nuclear-Powered Surveyor Vehicle Depicted

At the concept of Hughes Aircraft Co.'s Surveyor orbiting lunar vehicle shows the U.S. a long-11 nuclear power pack in down-dropped device detail with cylindrical probe-tower. This 10-ft. three-dimensional power unit would provide a minimum of 25 G watt of electrical power continuously for 90 day missions.

construction of additional stages. Dr. Konstantin T. Logvinov, Soviet Engineer, admitted last week that Soviet nuclear satellite technology was less advanced than that of the U.S. and that the USSR was pushing from U.S. experience in this area. The building of a ground station within the Soviet Union to recognize weather satellites and process their photographs was held to be possible by Logvinov.

Agreement on the proposal, which was announced here recently, stresses that a United Nations General Assembly resolution urging international cooperation in space and from an exchange of letters between President Kennedy and Premier Khrushchev (APR 20, p. 21). However, the proposal seems to fall far short of the President's program, which also involves mapping the earth's magnetic fields, joint oceanic research satellites and a bank for space medicine data. All except the latter were endorsed by Khrushchev.

NASA Contracts

National Aeronautics and Space Administration recently awarded the following contracts and research grants:

1. **CONTRACTS**—WASHINGTON, D.C. (APR 19)—Hughes Aircraft Co. and the University of California at Los Angeles have been awarded a contract for the development of a nuclear-powered satellite system. The contract is for the development of a nuclear-powered satellite system. The contract is for the development of a nuclear-powered satellite system.

2. **CONTRACTS**—WASHINGTON, D.C. (APR 19)—Hughes Aircraft Co. and the University of California at Los Angeles have been awarded a contract for the development of a nuclear-powered satellite system. The contract is for the development of a nuclear-powered satellite system. The contract is for the development of a nuclear-powered satellite system.

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BOILING/VERTOL 107 has been docked at Texas Tower 2 during recent demonstration of the new towers, one landing helicopter's approach in the vicinity of supporting the related USAF early warning radar stations off the New England coast. Boeing/Vertol H-107A single-engine helicopter supported Texas tower for an hour.

Texas Towers Get Twin-Turbine Support

By James D. Hendricks

On AFB, Miss-Sound, parked and safety advantages of twin-turbine helicopters are significantly expanding the movement of personnel, equipment and supplies between the Air Defense Command (ADC) base on Cape Cod and USAF's Texas towers early warning radar stations in the Atlantic Ocean.

An AFB is nearing the selection of a winner in a competition between the Boeing Co.'s Vertol Division and Sikorsky Aircraft Division of Utahville, Aircraft Corp. to provide two-engine VTOL vehicles for Texas tower support (AW May 12, p. 247). USAF will purchase an operational helicopter for the job, rather than sponsor a development program.

Three S-61As Used

Three Sikorsky S-61A twin-turbine helicopters are currently staging from Cape Cod tower flights. These aircraft, modified slightly to accommodate tower support requirements, began operations here in March on a one-way helicopter from the Navy. Sikorsky originally received three under the Navy's HSS-2 designation for use in amphibious warfare, and each VTOL had about 15 hours of flight time logged when it was

turned over to the Air Force.

Sikorsky is making its competition bid with the S-61A, and if that company wins, the three helicopters already used will remain here as the first aircraft in a fleet of undetermined number. Even if Vertol gets the decision, the S-61As probably will be kept at Cape until the bid is accepted next March.

Last December, Boeing sent a Vertol 107 Model 2 (AW May 6, 1961, p. 52) twin-turbine helicopter to Cape for a week-long demonstration of its adaptability to the Texas tower support role. It is the same aircraft now in use, as an order by the U.S. Marine, Army and Air Force, the Canadian and Swedish air forces and Kawasaki Aircraft Co. of Japan. New York, Boeing has ordered the mechanical version of the Vertol 107.

While the 107-2 and the S-61A vary in design and specific performance, general pilot opinion here is that either is well suited to the tower mission. One pilot told Aviation Week he preferred the engine placement and overall design of the S-61A, while another said he liked the manhandling features of the Vertol 107-2 better than the side-loading process of the S-61A. On the whole, however, the man who will fly the winning helicopter as

single tower support, schedules appear to be neutral on the choice and satisfied with both.

Unique Missions

Support of the two Texas towers, anchored on pilings to the ocean floor about 55 mi apart off the New England coast, presents a unique set of logistical, maintenance and safety requirements. They are operated and supported by ADC and personnel of the 51st Helicopter Squadron of Cape Cod Air Force Early Warning and Control Wing, commanded by Col. Ernest J. White. Each tower is manned by approximately 65 personnel at all times, and there are now dependently on helicopters for a link to the mainland.

Helicopters supporting Texas towers perform these major tasks:

• **Personnel movement.** Duty rotation details each man to 24 duty on a tower, 14 duty days on land, and then return to the radar outpost. The 51st schedules many of its flights to move these personnel to and from the towers, at the same time carrying mail and other small items to the limit of load capacity. The helicopter can on standby to transport medical and other emergency cases from the towers to Cape. The 51st also ferries support, water



LOGGING S-61A robs on Texas Tower 3 dock in the Atlantic Ocean after ferrying personnel and equipment on scheduled flight. Three S-61As serving seven as on helicopter base Navy, will operate at Cape Cod if Sikorsky wins tower helicopter competition.



BUCKETED BY WINDS lifted over, moved and between tower radars, S-61A completes tower mail delivery missions on Texas 2.



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Throughout his existence, man has always lived in an environment that nurtures life, surrounded by his fellow man.

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chance of return, a space traveler must have equipment whose mean time between failures is 1000 times the expected length of the flight. This means that on an 8½-month trip to Mars the vehicle would have to be built to last more than 700 years.

Certainly no one is more aware of these immense reliability requirements than the engineers and scientists of the aerospace industry. Time after time they are called on to assure reliability in systems that have not even been designed. And time after time the demand reliability has been there when needed.

These unrelenting efforts by the aerospace industry are helping the Free World's astronauts in their conquest of outer space. They are helping the loneliest men on the loneliest job in the world today.

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and conductive personnel between the base and the tower at the direction of ADC's 4604th Support Squadron, the Ota unit charged with operation and maintenance of the tower system.

• **Movement of equipment.** The 551st carrier (Radio Det of Communications Plans (RDCP)) to the tower and other gear which does not exceed helicopter load limits. Heavy equipment is moved aboard a 185th Military Sea Transport Service supply ship, the *New Bedford*. The ship comes from the port and other stores to the tower from its home port at New Bedford, Mass.

• **Tower evacuation.** Following the collapse of Tower 4 (a violent storm off the New Jersey coast on Jan. 15, 1961) a disaster that took the lives of 41 men aboard—USAF established procedures to evacuate Towers 2 and 3 (Tower 1 was never built) when single men in stress loads in the 16-ft range threaten that area of the At Sea.

All stores which might conceivably come into the Texas tower region are carefully watched by USAF weather satellites in the Atlantic and along the eastern seaboard. Tower 2 is located about 100 mi offshore, due east of Chatham, Mass., and approximately 130 mi east of Ota. Tower 3 is about 45 mi offshore, slightly over 60 mi southeast of the base.

Flight time to Tower 2 is a two-minute helicopter under normal conditions is a little more than one hour. About 30 min are required to reach Tower 3. With two S-61s, Tower 2 can be evacuated in roughly three hours. One S-61A can rescue all personnel from Tower 3 in two hours. Fuel is stored on both towers in a pleated helicopter supply.

Storm Air Detection Section head quarter determines the degree of loss and passed by each storm, following it constantly in case it should suddenly divert into the tower area. A series of five "evacuation phases" has been set up to govern preparations for and actual removal of tower personnel.

Evacuation Procedures

At Phase 1, all 551st pilots and maintenance personnel are placed on alert, and all helicopters are readied for immediate launch. If tracking indicates report that the storm is headed for the tower, Phase 2 is called, and the tower is evacuated down to 21 once each, enough to maintain radio operation without maintenance capabilities.

Phase 3 signals total evacuation—a procedure which has been followed 13 times in the 36 months since Tower 4 was lost. Phase 4 indicates that the threat has subsided, and helicopters



Continental T72 Completes 50-hr. Test

Continental Aviation and Engineering's T72 12 turbine engine has completed U. S. Navy 50-hr. preliminary flight testing and has been flight tested 10 hr. as a Republic F4U helicopter, U. S. Navy version of the French Sea Hawk helicopter. Flight testing was conducted from ground level to 12,000 ft.

When the personnel in the tower.

During the hurricane season, if a storm moves north beyond a line drawn through the center of Florida, Towers 2 and 3 are evacuated immediately.

On at least two occasions when Tower 2 was completely evacuated during heavy rain, crewmen from Houston flying turbines in the area have been reported as attempting to board the radar station. Both times, U. S. Navy's in the area have apparently frightened the Russians away. Although USAF will make little comment on these incidents, an officer at Ota stressed that the towers are not self-sufficient. Survival of the tower by aircraft and surface vessels is used to maintain security of the towers and their radio equipment.

Second in primary responsibility for Texas tower support, the 551st Helicopter Squadron performs other services in assistance of civil and military operations.

The 551st frequently supports USAF, Navy and Coast Guard search and rescue units in seeking the location of downed planes and wandering ships and rescuing personnel from them. In the winter particularly, haze becomes a problem. The 551st is required to maintain the water temperature regularly drops as low as 30 to 10°F. Even in an aqueduct water, a run from ditch without a raft into water that could not be expected to survive so many days as long.

Officially, rescue isn't our busi-

ness," says a 551st pilot, "but when there's a man in the water closer to us than to a rescue station, we go after him in a hurry."

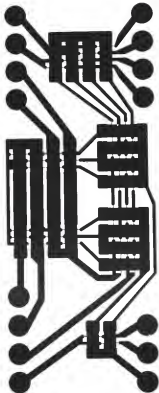
Occasionally, fishing boats from the New England ports are captured and the Ota helicopters are called upon to aid the Navy and Coast Guard in search and rescue operations. The 551st assisted in removal of passengers from the ocean liner *Andrea Doria* in 1956. The ship was sinking after a collision with another vessel, the *Stockholm*.

Four former Pennsylvanians are assigned to the Ota base helicopter, and at least one has each helicopter as rescue and medical evacuation mission. Each Texas tower has a medical technician on board at all times to give resuscitation and to resuscitate personnel. Litters are kept on the tower, so that the patient may be quickly loaded should the helicopter.

Flight Schedules

Normal flight schedules for tower support call for trips to Tower 2 every Tuesday and Tower 3 every Thursday. Wednesday is set aside for supplemental or backup flights to Tower 2, and Friday is reserved for the same purpose for Tower 3.

Loading capacity for each flight is determined by the 551st, normally 4, 500 lb. in Tower 2 and 3,000 lb. in Tower 3, both figures applicable to the S-61A. The 4604th Support Squadron handles the helicopter work at loading



NEWS...OF DEFENSE TECHNOLOGIES

GUIDANCE

There are vast differences between the techniques required to guide missile flights and those needed for space vehicles. Entirely different problems are presented in the tasks of guiding an anti-rocket missile having a few thousand yard range, sending an ICBM to a target thousands of miles away, and locating new test instruments in the frontiers of space. Experience in each is invaluable in satisfying new mission requirements.

General Electric is protecting infrared guidance for the Side-winder, inertial guidance for the Polaris, and the radio-command system for Atlas ICBM's. It was this phenomenally accurate radio-command guidance that helped put the Mercury-delta into earth-orbit.

This wide range of guidance experience is enabling General Electric to apply new devices and techniques (such as electrostatic gyros and ephemeris) directly to existing problems, thus providing continuous and significant spreading of guidance technologies and capabilities. Current activities include development of reference navigational systems for space and exploration of the best combinations of basic guidance forms for the sophisticated missile and space vehicles of the future.



GYROSCOPIC PROGRESS in inertial guidance is typified by the 32 gyro legs claimed for constable, leader, more reliable computers. Other current systems work include high-precision gyros and accelerometers.



ELECTROMAGNETIC GRAC are being developed to meet future missile needs for antennas up to 3000 feet greater than those obtainable with present gyros. Other systems may be as complex and long life.



STARFIRE TRACKER provides a visual star pattern against a closed reference map for spacecraft attitude control. This device may replace the inertial with its no maintenance because of its zero drift.



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Sud Alouette 3 in Production at Morignane

Sud Alouette 3 helicopters, designed and Alouette 2s, are stand ready for delivery to customers of Sud's Morignane factory near Mantes-la-Jolie. Sud currently is producing 36 Alouette 2s and four of the larger, more powerful Alouette 3s per month. Alouette 3 production rate is scheduled to be increased to eight per month by June.

breakdown in terms of personnel, equipment, supplies at a combination of men and materiel.

"We try to get a full load on every trip to get the most benefit from the human cost," explains May. George S. Mott, Jr., 40416 commercial. "That's never say no problem. We've sort about everything imaginable to the situation. A while back, we had a boiler failure on the Tower 1, so we picked up a replacement from the manufacturer's plant in France and flew him out here to handle repairs."

More than 130 men are assigned on rotational duty to each of the towers. Each assigned duties 15 round trips a year between the base and the tower. About 2,000 personnel have been trained each year on round trips in the 551st.

Although the Orléans helicopter pilots have flown to the tower as much as 10 to 12 and during years on several occasions in the 6th year they have suggested the Tower towers, the New Bedford is on standby to handle personnel movement during emergencies at a time when weather conditions prohibit flying.

H-21B Operations

From December, 1955, when the 551st began supporting the towers, until late last year, Borg-Warner H-21B single-engine helicopters were used. Despite drawbacks in speed, payload, unrefueled range and safety, because the H-21B achieved what the 551st needs in the least helicopter safety record in the Air Force—2,800 tower flights covering more than 100,000 air miles without a single fatality or serious injury. Seven H-21Bs are still used here for backup tower support and rescue operations.

Only one H-21B was lost in the six years that the Vertol helicopter was making regular flights between Orléans and the towers. In 1958 one of the aircraft crashed in the Atlantic after an engine

failure about 50 mi from Tower 2. All passengers and the crew were picked up by an accompanying H-21B and surface craft.

Due to the hazards inherent in flying over water with one engine, the H-21B's about four in pairs to insure that if one had to ditch, the other was available immediately for rescue operations. For that reason, neither aircraft could carry more than a full load. With the H-21B's 16 passenger normal capacity below, some flights were necessary then are now required with the larger twin-engine helicopters which are unaccompanied. The S-61A carries 27 passengers, normal 197-2 passenger complement at 25.

Comparisons between the H-21B and the competing twin-engine helicopter reveal:

- Increased speed. Normal cruising speed of the H-21B was approximately 55 kt. This has been increased to about 130 kt. in the S-61A, roughly the same as the 197-2.
- Greater unrefueled range. Full fuel load on the H-21B was 1,400 lb. Even with this load, the older helicopter was required to land at Chatham for refueling on a mission to Tower 2, so that if it could not land and return to the Tower, it could at least return to Chatham. The S-61A has a fuel capacity of 4,900 lb. Vertol 197-2s can carry about 4,225 lb. of fuel on tower flights, more than enough to make an unrefueled round trip flight to the more distant towers.
- Heavier loading. The H-21B was limited to carrying only about 1,240 lb. on full fuel load to Tower 2, or 1,750 lb. on two fresh fuel to Tower 1. Also, the 490-lb. often had to send men and equipment by surface transport to Chatham to be picked up at the local airport there for mission to Tower 1 by the H-21B, because the Vertol helicopter could not carry heavy loads than that without exceeding load requirements of 4,900 lb. to Tower 2 and 5,600 lb.

to Tower 3 full early within the capabilities of both the S-61A and the 107-2. "The twin-engine helicopters have solved about 70% of our transportation problems," Mott says.

•Greater safety margin. Besides the necessity for flying in pairs to insure rescue capability, the H-21B's rotation gear consisted basically of added on emergency equipment, rather than built-in rotation capability. The H-21B had one emergency, self-storing float, behind the engine compartment. A deflated float bag was attached to each side of the landing and inflated with air accumulator of the helicopter was forced to land down on water. The S-61A and 107-2 have integral flotation equipment in the form of boat hull and spousals.

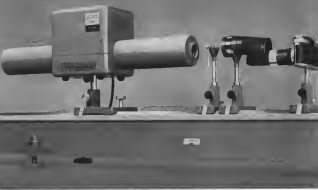
Boat hulls on the Sikorsky aircraft used at Orléans were sealed after trapping and radio interference and in the 1958-59 configuration. Other modifications for the Vertol towers include installation of the ASW armor gear, installation of in-flight gear, and installation of the rescue equipment.

The S-61A carries a 10-man crew, fuel and fuel and supplies. More crew are provided if the passenger complement exceeds 20. Each crewman and passenger wears the standard bright yellow rubber anti-exposure suit and a Mae West life jacket. Crews receive training in water survival on the base and in simulated ditchings at sea.

Flight Profile

Tower flights normally operate at altitudes between 700 ft. minimum and 1,200 ft. maximum. Orléans has first, from a safety viewpoint, authorization to fly at or above the 700 ft. minimum, while the 1,900-ft. maximum is observed because operators require the availability of parashutes above that altitude.

Towers and ASW navigation equipment is used above the S-61A during



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tower flights. The helicopters are tasked while over the water by radar on land and given radar piers from the towers. One pilot said the 552nd would like to have a lightweight Doppler system of one can be found which affect extreme navigation accuracy and reliability without reducing the helicopter's load capacity.

On a clear day, the tower becomes visible on the horizon from almost 40 mi out. Each tower deck is more than 80 ft above the water, and total height from the top of the tallest column to the water is approximately 150 ft.

Approach speed to the tower is about 60 kt, and the helicopter usually makes a pass about 400 ft. above the radarome to determine wind direction and velocity. The radar must be shut off while the helicopter is airborne within a half mile of the station to protect against the possibility of radar returns to personnel aboard the aircraft.

Hoof and landing on the triangular tower deck is a pervasive flying insect trap, more wind two percent as especially critical problem. The landing area is about 40 ft wide at the seaward landing point tapering to a smaller point at one end and closed off at the other by the columns and support structure.

"When the wind comes from behind the radome, it's a real headache," one pilot says. "The wind diffuses over, around and between the radome and hits you from three directions. All you can do is feel your way in until touchdown."

The Soviet has experimented with the procedure of a man on deck giving visual steering information by radio to the helicopter pilot during the debarco landing maneuver, much in the same manner as pilots receive landing instructions from the deck of an aircraft carrier. The first time this was tried here over some waves showed out effective communications between the deck and the helicopter.

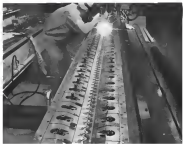
Maintenance Procedures

Maintenance of the 551st helicopter is handled by 12 personnel from the base. Flight maintenance troops of the 551st Organizational Maintenance Squadron for engine mechanics, electrical technicians and hydraulics and flight control systems specialists are available on the base.

The safety and reliability requirements are particularly stiff for the filter behavior because of the consequences

helicopters, because of the individual nature, and maintenance personnel have claims that they expend more hours maintaining their aircraft than an entire USAP helicopter unit. "As a re-

Over 12-month periods throughout



Automatic Welder Used for RS-70 Ribs

Aircraft use wire welding of North American B57B titanium air structures is accomplished at Yoko Jima, run by Chugan Vongit Corp. with a fully automatic laser welder fitted with an inert gas chamber to provide proper atmosphere during cooling period.

in use in the lower program, the Vertical Ejection averaged 98% monthly aircraft availability. With the 13-21B and the S-61A, inspections are divided over regulation requirements. Scheduled goal is two of the three S-61As on hand to be available at all times, and the third to be pulled out of maintenance and readied immediately for flight in times of emergencies, such as tower evacuation alerts.

Daily preflight inspections for helicopter scheduled for flight that day average about 24 minutes per aircraft. Preflight inspections and maintenance records use minutes per helicopter, including visual checks, lubrication and correction of crew warnings. Occasional "washdown" of the helicopters are needed to clean off salt spray, mud,

A team of Sikorsky pilots, flight engineers and mechanics accompanied the S-61A to Ota for "over the shoulder" supervision of Air Force air and ground crews. By mid-June, 20 personnel from the 51st Organizational Maintenance Squadron will have completed a new two-course in S-61A maintenance at the company's Stratford, Conn., plant. Sikorsky says that, besides being trained,

One is presently following New HHS-1 maintenance procedures and



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Directed and controlled into payload of Piasecki Aircraft Corp.'s twin-engine Vought V-440, vehicle results in improved forward thrust and places pilot in normal flight attitude by allowing need for steep nose-down attitude at forward flight. This Army vehicle is halfway through its ground and flight tests and will leave the Piasecki plant this summer for Army and NASA flight tests. It has flown with five persons aboard. Vehicle has all-terrain wheel/payload links, and is powered by two Turboprop Aircraft 2c turbines.

Piasecki Tests Twin-Turbine and Seagoing VTOLs



Piasecki Seagrip is equipped with helicopter float. It is currently at Potomac River, Md., Naval Air Station, undergoing rough-water exterior and sport-poleman/grasping tests. These photos show Seagrip undergoing tests on Delaware River.



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Entered electronics field with development of one of first radio control systems for drones.



1952
Developed "Glass Box" emergency radio transmitter, featured in seven lives of every World War II pilot named it his.



Participated in early "Bartolucci" missile program with development of automatic and operational test rules.



Entered sonar field with development of depth recording equipment for Navy.



Participated in development of active radar bearing guidance system for missiles.



1954
Introduced first high pressure hydraulic system for submarines.



Introduced first integrated missile hydraulic system.



1956
Developed completely self-contained telemetry system for Atlas ICBM and associated nose cones.



Developed first airborne scanning sonar.



Selected as number of teams to develop 12 weather ground observation and tracking systems for Project Mercury.



Acquired new Electronics Center, an advanced center including largest indoor sonar test tank.



This year Bendix-Pacific celebrates its 25th anniversary—25 years of pace-setting achievements symbolized by those which are noted above. These and other Bendix-Pacific achievements have consistently demonstrated the "Imagination plus" of Bendix-Pacific—the driving creative curiosity coupled with experience in doing which has made

Bendix-Pacific a leader in the fields of Airborne Radar, Data Handling, Guidance, Hydraulics/Pneumatics/Electro-Mechanics, Military Navigation, Ordnance and Telemetry. For information on how Bendix-Pacific "Imagination plus" can go to work for you in any of these fields, call or write Bendix-Pacific Division, North Hollywood, California.

Bendix-Pacific Division





MARTIN BULLPUP air-to-surface missile is hoisted from U.S. Air Force F-100. Missile also is operational on F-105.

Bullpup Sets Marks for Production, Cost,

By David A. Anderton

Orlando, Fla.—New production marks are being set by the Bullpup air-to-surface attack missile, in production at Martin Co.'s Orlando Division long for the Air Force, Marine Corps and Navy. Missile deliveries to the Navy which originally developed the requirement and awarded the first production contract, have been on schedule for 18 consecutive months. Spares and logistics support items have been on schedule for 17 months.

Air Force Bullpups have been delivered on time since the inception of the program almost four years ago. Both documentation and hardware have been on schedule for 47 months.

Continuous reliability specifications have been exceeded in all production months for the past four years. One indicator of the importance of built-in reliability: Martin guarantees that the missile will accept guidance after launch.

While these marks have been achieved, the cost of the production Bullpup missile has dropped steadily since it entered production. Today's missiles cost only one-third of the price of the first production missile.

This record has been the end product of a Martin team approach that starts with Counsel Manager G. T. Wilkes and goes through the current Bullpup program manager, Lee Schmidt, right down to the girl operating soldering machines on the production line.

The missile firm became operational just three years ago, when it joined strength of the Seventh Fleet on sta-

tion in the Pacific. Since then, it has been in a continual program of product improvement and cost reduction, which has seen the introduction of new models to the two contracting services at considerable cost savings.

During the first year of missile production, Martin cost reduction work and the Navy almost 57 million.

Bullpup Models

Air Force, Marine Corps and Navy are buying a variety of Bullpup models under a number of different names and designations. There has been some confusion in the program because of other code names, such as Bulldog and White Lance, which have been connected with the Bullpup. Further confusion comes from the "new" Bullpup, which has neither name nor designation available now, the only certainty is that its designation will be the next logical one.

Generally, there are six recognized Bullpup names in production, in development, or under contract:

- Navy ASM-N-76, also known as Bullpup A. This 11 ft long missile has a one-foot body diameter, carries a 250-lb conventional high-explosive warhead over a range of 10 to 15 miles at speeds near Mach 2. It weighs 571 lb in Navy installation, costed comes from a "hang-tag" system, in which control deflections are always left, but applied only for an initial 10 sec.
- Air Force GAM-63A, basically identical to the Navy ASM-N-76. The difference is that the GAM-63A has a proportional control system for controlling control-surface deflections, so

that partial deflections can be held for long periods of time. This model was originally named White Lance by USAF, which wanted to avoid using the Navy name.

- Navy ASM-N-70, also called Bullpup B. This version is 15.6 ft long, has an 18-in body diameter and weighs 1,235 lb. It carries a 1,000-lb conventional high-explosive warhead over a range from three to nine miles at speeds above Mach 2.
- Air Force GAM-69B, generally called the Nuclear Bullpup. The "B" is the designation under it may be confused with the Bullpup B name. It is really not one of these, but more closely resembles the Bullpup A. The GAM-69B is basically an -63A with lengthened center body section to contain the nuclear warhead, fusing and arming systems. In addition, the -69B will use an off-landing guidance system, with which the pilot can control the missile from a parallel course, thus minimizing the distance between the launching aircraft and the nuclear deflection.
- Air Force TGM-40B, the training missile for the Bullpup. This model uses a five-inch diameter HVAR (High-Velocity Aircraft Rocket) driving a proportional guidance head which gives a total aerodynamic performance identical to a full-size missile. The training weapon started as a Navy idea, but when that service couldn't find the development, USAF picked it up. Martin's Orlando operations were awarded, so the work was done at the Baltimore division. Navy has indicated it will buy more when USAF buys them off at qualified cost. Cost of the training


NAVY F-4D PHANTOM II is armed with four Bullpups. Trainer pod is attached to tailboom pylon under aircraft's right wing.

Reliability

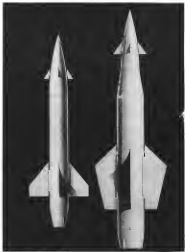
missile is about one-quarter of that of the Bullpup missile it replaces.

- Air Force "New" Bullpup, which will not carry the logical designation of GAM-64C. This program was initiated last week under a \$500,000 letter contract with the Air Force, covering research, development and testing of the new model. Bendix Corp. has been named associate contractor with Martin in a significant firm previous position. New wire system and guidance system will be required, having at specialized missions or targets. One specification the missile will be able to home on actively rotating targets, such as radar.

The Bullpup now is a two-weather bird. But there is a program under way to develop night and all-weather guidance systems. One of these will be used on the German Air Force series of aircraft, which will use the Bullpup for strikes against targets illuminated by the radar in the launch aircraft. The display information will be shown on the ACF's Ducas console on integrated display system that presents environmental and target features.

About a year ago, the Navy answered the first night firing of the Bullpup against a target illuminated by a 70-watt radio-frequency searchlight, presumably carried by the launching aircraft. It was fired at the Pacific Missile Range, the Navy said it "splashed its target dead."

Other guidance systems have been tried, one of these was the TVRG type (Television and Inertial Guidance). In this system, one of three being tested by Bullpup is one time, the inertial sensor came from television data-



MARTIN'S COMPARE relative size of Bullpup A, left, and Bullpup B.

ENGINEER-MANAGERS

KEEP R&D PROGRESS AND COST ON TARGET AT HONEYWELL

Unique approach controls costs and deliveries without inhibiting creativity

Five years ago Honeywell determined that operational R&D management techniques would be applied to cope with the growing complexities of Honeywell's aerospace programs. The myriad of project tasks needed costs management control. Business managers were too far removed from their engineering counterparts to keep tabs on hundreds of daily problems.

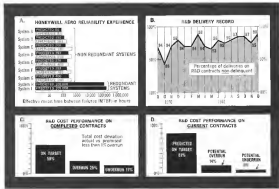
The solution? Put business control tasks and responsibility in the hands of the "front line" project engineer—short, control at the point of accomplishment. Honeywell calls it R&D Command Control. The result? It has kept its expanding aerospace aerospace operations' R&D cost engineering burden rate 13% to the end of last year. • Controlled costs to within 3% of the

net amount costed on R&D progress over the past two years.

• Achieved, or bettered, predicted cycle time reliability on every major aerospace program.

• Improved delivery performance—delinquencies on R&D contracts were reduced to five per cent in 1961.

This indicates that contrary to popular belief, innovation can be managed—without impairing creative performance—when engineers are given responsibility for the business management of their projects. And what's more, time and cost schedules are met!



HONEYWELL R&D PERFORMANCE proves the effectiveness of its Command Control systems. Chart above shows (A) predicted vs. demonstrated reliability—Honeywell has equalized predicted vs. demonstrated reliability on all major aerospace systems. (B) delivery

performance on R&D contracts at Honeywell Aero Division, Minneapolis. (C) cost performance on completed R&D contracts, and (D) cost performance on current R&D contracts. Note the cost performance improvement between charts (C) and (D).

PERT-Cost Tie-In

R&D Command Control at Honeywell is dynamic—improvements are continually underway. One of these improvements is the development of a standard relation ship between Honeywell cost control techniques and recognized technical progress evaluation techniques like PERT (Program Evaluation and Review Technique). Basically, five concepts underlie both of these systems; consequently they are highly compatible. Their advantage promotes simultaneous evaluation and control of cost and technical progress—a first step toward the ultimate goal: keeping performance and costs on target.

Applications of these developments to Honeywell military and space programs is advancing the state of the art in R&D management and maintaining Honeywell's reputation for leadership in this field.

5 concepts are key to Honeywell R&D Command Control

Simply stated, these five basic ideas underlie the advantages of a system that provides effective R&D control at Honeywell:

Creative work can be managed. R&D Command Control experience has convinced Honeywell engineers of this.

Control must be at the point of occurrence. The front line supervisor on the field position to correct problems where they occur.

Technical progress and cost control are inseparable. Command Control combines both cost and

technical decision making at the front line level of supervision.

Tasks must be managed as total project items. Supervisors must be given the total project picture to produce action consistent with overall program objectives.

Problems must be detected early. Honeywell recognizes the high costs of R&D work and realizes that all levels of management, as well as the customer, must know of problems early enough to take corrective action. Only in this way can expenses be minimized and schedule slippages prevented.



Honeywell R&D control applied to these major programs

With the award of the Apollo contract, Honeywell is now a major contractor on the Apollo Mission Service and X-15 manned space programs.

Honeywell's space vehicle experience began with the electrical reference system for Vanguard. Subsequent assignments include the attitude stabilization and control systems for Project Mercury, the 3-axis reference systems for Titan, Agena, Thor Delta guidance and control systems for Scout, inertial platforms for Polaris, inertial guidance for Centaur, flight control systems for Apollo and X-15.

Yet more information concerning Honeywell's R&D management control techniques contact Honeywell Military Products Group, Minneapolis 5, Minnesota. This advertisement is paid for by Honeywell, not from government funds.

To implement a Command Control concept, Honeywell uses six management techniques. These are briefly summed up:

- 1. Program Management** (on Milestones, Unit of Balance or PERT).
- 2. Reliability Engineering**—in staff operation, with specialists assigned directly to projects at their audit.
- 3. Value Engineering** (a combined educational/operational function when a specialist guide oversees approach of selective design and problems).
- 4. Project Management** (the actual, every handling of every duplex R&D project has resulted in the resolution of these additional techniques, all unique with Honeywell).

5. Project Responsibility. Each front-line supervisor is held accountable for the success of the specific task and the total project.

6. Project Cost Record. The front-line supervisor receives a running cost breakdown including predicted cost at completion vs. light with Honeywell after costs are received. This permits early prediction of problems and quick remedial action which ensure overall benefits to the project.

7. Design Process. This is a standard design sequence, not of experience, but of discipline, incorporated in a way that uses the full experience of the organization toward obtaining the highest probability of success.

Honeywell

Military Products Group

for Ballpuq require that the missile have an overall high reliability, with a percentage figure defining the meaning of "high." Part of the reliability requirement is that the missile accept guidance signals after they are launched.

The missile was originally designed with payload test equipment so that guidance-signal acceptance could be checked before launch. But this proved so unnecessary that Martin and the Navy agreed, after sufficient data had accumulated, to remove the requirement for payload test and attach the equipment from the contract.

Ballpuqs leave the factory and are not checked again before flight. Proof missiles are selected from each production lot and fired to check compliance with the specifications. If they don't meet the requirements, the entire lot goes back to Martin for rework. If they do meet the reliability percentage, the entire lot is considered reliable and is used by the fleet as ammunition.

Martin sources say the Ballpuq program to date has shown reliability figures well above the Navy requirement which, they point out, was a high one in the first place.

Ballpuq goes to its use in three or more: nose, center and afterbody. The afterbody and center sections are joined in the magazine on board ship; they are transported in a module stowable gun and the nose section is passed to the use of the missile.

The body is hung on the launcher and then the wings and control surfaces are clamped in place.

Ballpuq Carriers

The Ballpuq is operational on two USAF aircraft—the North American F-100, which carries two of the missiles and the Republic F-105, which carries two on four Ballpuqs. It is also on the F-4D, a version of the McDonnell F-4H Phantom 2 to be built for the Air Force.

The Navy's North American F-4B carries five Ballpuqs under the wings, two under each side with a guidance pod and three under the other. The Douglas A-7D also is armed with Ballpuqs, carrying four under the fuselage and two under each wing. The Ballpuq is scheduled to become an operational weapon with the General Voltage F3U ZNE, the McDonnell F-4H and the Grumman A-7.

Under NATO production plans, Ballpuq will be built by a European team, and will arm aircraft of Norway, Denmark and Turkey. It will also be used on the Royal Navy's Blackburn Buccaneer, Vickers-Siemens and the Harrier Sea Vixen.

All Ballpuq modules built so far consist of three basic components: nose, center section and afterbody. Only the



French Test Postal Rocket

French postal rocket, which has been under development for several years by the French post office, has been deep tested from French borders. Missile, built by Latécoere Co., was lowered by parachute and landed on impact legs.

nose is built in both Ballpuq A and B series, and it is interchangeable from one to the other.

The nose has an ogival shape, is about 13 ft long and has a base diameter of six feet. It mounts four curved control surfaces about two feet back of the nose tip; these controls have a delta-wing planform and a double wadly airfoil section.

Inside the nose are located the nose mount receiver and the complete control system. Signals from the launching aircraft are received and translated for the control package. Actuators move the control surfaces which produce aerodynamic forces and moments to guide the Ballpuq.

Center section is normally made in three forms which go with each of three different types of missiles. The first for Ballpuq A and CAM-61A, is a cylinder six feet in diameter and about four feet long. It carries a 250-lb. conventional high-explosive warhead.

Second version of the center section is for Ballpuq B. It expands from a six-foot diameter to an 18-in. diameter by means of a truncated-cone transition section at the forward end. Overall length of the B center section is about 4.5 ft. It carries a 1,000-lb. conventional high explosive warhead.

Third type of center section is made by the CAM-61B, the smallest Ballpuq. It has the basic nose-diameter of the Ballpuq A series, but has an increased length to house the nuclear warhead.

The afterbody is being produced in two versions. First of these is for the Ballpuq A and the CAM-61B. It is a six-foot six diameter and about 3.5 ft long. Four truncated-delta finned surfaces are mounted externally on the afterbody; span of the surfaces is about 3.5 ft.



The packaged rocket powerplant is carried internally.

Second afterbody section, built for the Ballpuq B, matches the 18-in. diameter of the larger version, and is about 5.6 ft long. It also mounts four finned surfaces but these have trapezoidal planforms with raked tips. Span of the surfaces is about four feet. The afterbody carries packaged powerplant internally.

Packaged Power

Two packaged liquid-propellant rocket engines have been developed and produced for the Ballpuq program by Reaction Motors Division at Thiokol Chemical Corp. Ballpuq A missiles now are powered by the 17,000-lb. thrust LR50-RM-2 engine, with a total burn time of 4.5 seconds. Ballpuq B missiles are driven by an LR52 engine, with a higher thrust and longer burning time than the LR50.

Both these engines burn in a main hot with subchamber and nozzle and an oxidizer. A double-base solid propellant permeates the high strength aluminum linkage to drive hot and oxidizer to the combustion chamber. An insulating layer, consisting of a final step during missile assembly process, starts the engine cycle.

Engine comes up to full thrust within one tenth of a second after the arming time. The combustion chamber is sealed airtight by the nozzle fire; the chamber is also sealed with ceramic over the throat and nozzle section.

Both powerplants are designed for a forward storage life. Storage temperature range requirement is -30° to 160°F; firing requirement is the stored and -50° to 30°.

Handling and storing of the engines pose no special problems, and there are

Raytheon 20 photo Laser penetration starts to explode balloon

Raytheon / Laser Military Systems Applications

One of the first to develop an operating laser, Raytheon has since directed its efforts toward high energy lasers for systems applications. Today, other solid-state materials and gas lasers are being studied to determine their ability to produce pulsed or cw coherent light. Raytheon's extensive background in designing power supplies for high power microwave equipment has rapidly advanced its laser development.

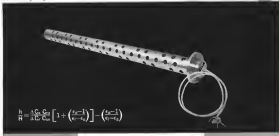
Application of laser principles now being explored at Raytheon include communications, illumination,

aids in imaging, underwater systems, airborne altimetry, guidance/velocity sensing, ranging/detection systems and weaponry.

On request, Raytheon will demonstrate its equipment and discuss laser military and systems applications. For complete details, write: Raytheon Company, Equipment Division, Department 8039, Weyland, Massachusetts.

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be shipped either loaded or unloaded. Six-foot drop testing is a requirement for qualification of the powerplants.

Concept of the packaged engine was developed to an advanced design by General powerplant engineers during World War 2, and was continued in the U. S. after the end of the war. U. S. Navy's Bureau of Aeronautics sponsored a design contract in 1958 to develop such a packaged engine with the capability of being handled like solid propellant engines or a normal aircraft engine.

RMI developed the concept, current production engines are essentially the same in the original studies done in 1950. Two years later, RMI received a letter contract for development and test of packaged engines and continued the work through design of a 4,000-lb thrust, three-second burning time engine.

Baker requested proposals for the Sparrow 3 powerplant line in August, 1949, specifying a packaged engine for the job. RMI won the contract and started development of the engine in December that year. Development and testing qualifications were completed in two years and the engine design (RM-45) was sent into production in August, 1958. The following month, RMI was awarded the contract to develop the Sparrow 4 engine.

Program Dollars

Total funding of the Ballpop program to date approaches \$174 million. This figure is made by standards previously applied to similar systems. But at the current production cost of a Ballpop—nowhere near \$2,000—it represents a lot of money.

The first production contract for the Ballpop was awarded in March, 1955. Money made during that first year of production cost three times the current

price, and costs are still being reduced under a series of programs spearheaded by Martin's General Manager G. T. Wilkes. Cost curves on the Ballpop decrease with it. Orlando. But instead of dollars, the markers on the curve of cost against time are little coins of valuelessness. At the upper left-hand corner is a Cadillac, at the lower right, a Chevrolet. "The cheapest one," says Wilkes. Obviously, the next step is indicated with a marker of a Volvo wagon, but in one office, the next chart has been extended across its border and into the wall. At the end of the line is a cut-out picture of a child's toy car.

Rockete the Navy has brought W. L. Manton Corp. into the Ballpop program as an authorized second production source. The plan for Manton's first production is similar to the one Navy set into operation on its Silvermaster program.

Development Program

Manton is now building Ballpop components, in part of a development program to get fully qualified components for the market. After Manton has met these requirements with its units, it will be considered a qualified production source, and asked to bid against Martin on the next production order for a batch of Ballpops.

The last part will get the largest percentage of the contract, with high bidder getting the remainder of the contract. Navy feels it will achieve cost savings this way. Manton welcomes the opportunity to focus its talents on the production. Martin believes it will be a good shape to win future competition because of its eight-year lead in experience with the weapon.

The concept of the Ballpop was one of the outgrowths of losses learned in Korea. These particular losses were learned the hard way by Task Force 77



Matra R.530 in Pre-production Phase

Two-stage Matra R.530 air-to-air missile, adopted by the French in their standard program of the type, is being produced in substantial numbers during pre-production phase.

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That's exactly what we would like to find out. Especially if it involves valves for missiles, aircraft or ground support equipment. This has been our business for 21 years at TACTAIR. Precision in our habit—in design, in manufacture... in "specialty", or "standard". The examples:



SMOKE Valve Assembly from Westinghouse. A gas valve valve designed to control exhaust pressure in gas turbine to liquid phase gas turbine and fuel. Used in gas turbine engine and jet engine. Also other applications in gas turbine engine. (See page 100).



DISCHARGE Valve from Westinghouse. A gas valve valve designed to control exhaust pressure in gas turbine to liquid phase gas turbine and fuel. Used in gas turbine engine and jet engine. Also other applications in gas turbine engine. (See page 100).



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pose, 500 mV full scale, 100,000
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Here's the one system that lets you record inputs from DC to 5 KC within 3 db at 4" peak-to-peak amplitudes, without changing galvanometers. The "650" system consists of an 8-channel modular unit, general purpose amplifier unit driving a high speed, high resolution optical galvanometer assembly. It can be easily built into your system, packaged in a module cabinet or located in individual cases. The single channel, 7" high amplifier module has 8 separate channels, complete from floating and guarded inputs to galvanometer output; each channel comprises a front end, modulator and input transformer, carrier amplifier, demodulator, filter and driver amplifier. Power Supply and Master Oscillator Power Amplifier are built-in. All amplifier elements are plug-in transistorized units for easy servicing.

Immediately readable recordings are made on 7" wide daylight-bleeding aluminum wet-sensitive charts which require no chemical development. Pressure of the 125" high recorder unit is stage 5 electrically controlled; chart speeds from 1" to 200"/sec; calibrated magnetizing screws, automatic time identification and timing loss at 0.01 or 0.1 sec, internally amplitude bias up to 0.1" apart which can be blanked from 1/2, 1/4, 1/8 or 1/16 of all chart. Recorder is available with an 8, 16, 32 or 64-channel galvanometer bank which is then equipped with the number of galvanometer elements desired by the customer. Either the Recorder or Amplifier are also available as individual units for use with other equipment.

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operating off Korea's east coast in late 1951, striking against Communist strong points with the time-honored dive-bombing method that the U. S. Navy had pioneered about twenty years before.

Task Force 77 was assigned to analyze its own bombing effectiveness and cost and to recommend a better way of it was indicated. Casualties, aircraft losses, bomb damage and target damage were among the many factors considered during the analysis. The final answer underlined one conclusion: Dive-bombing with itself was too costly in men and material.

Problem Solved

The Navy believed that simple, easy-to-use bombing technique wouldn't solve the problem, in effect, making a new type of weapon become available. The dilemma found resolution in the Bull pup program, which began with an industry-wide competition in 1954.

Marin was the only competitor and an initial \$2,870,000 from the Navy. Five years later, the first Bullpup missile became operational with Squadron VA-212, being North American F4H from the USS Lexington with the Seventh Fleet in the Pacific Ocean. Their early travels were powered by a solid-propellant rocket motor, modified as an interim measure until the final production LR35 engines became available. These solid engines were made at the Naval Propellant Plant in Maryland.

Navy Tests Rocket Communications Relay

Naval Electronics Laboratory has demonstrated use of a nonstandard Verner surface air vehicle system to launch a solid-state communications relay for long-range emergency fleet communications by VLF radio.

The test vehicle, called Vinta 100, consisted of a standard General Dynamics Titan booster and a Managuard Air 4 second stage built from a standard Titan launcher at Ft. Belknap, Calif.

The 50-lb communications relay, experimentally designed and constructed by Naval Electronics Laboratory, is called a single channel transmitter which sent a supermodulated signal that was received at the San Diego, Calif., headquarters of the laboratory. No actual attempt to relay messages between ground stations was reported by the Navy.

The third stage achieved a top altitude of 170,000 feet and supported 100 test air downrange of the end of a 10-min flight. It was the first time the rocket propulsion had been flight tested. No further tests are planned.

PRODUCTION BRIEFING

North American Aviation's jet ability transport, designated T-39 by USAF and T-37 by Navy, has received an airworthiness certificate from Federal Aviation Agency.

Managuard Corp. has received a \$171,995 contract from National Aeronautics and Space Administration to develop applications, hardware and software for the space-age industry's new super models, above high operating altitudes, combined with extreme temperature variations, must be controlled... exactly. A major item of this, while design is in its final stages, the Series 387 has, we believe, the lowest pressure drop of any propeller valve designed for fuel, hydraulic and pneumatic applications. Its control feature allows a high rate of flow at 5000 psi, at temperatures ranging from -45°F to +400°F.

Series 387 is considerably smaller than comparable valves capable of equal flow at 5000 psi. Smaller size and novel design drastically simplify its installation.

The unusual ballhead mount design allows the valve to function through extension up to 205 and shock loads up to 400. And its unique valve seat design enables the unit to withstand the erosive effects encountered in high pressure, high flow gas and liquid systems. Valve or coil holder for full details and ask for a copy of Valcor's catalog, "Valve Selections for Auto-Space Applications."

Sereno Corp., Berkeley, Calif., has purchased from Pacific Aeronautics Corp. a U. S. and Canadian rights in the design of the Spaceport General Dynamics Titan booster and a Managuard Air 4 second stage built from a standard Titan launcher at Ft. Belknap, Calif.

Winick Engineering Co., Pasadena, Calif., will supply equipment to check out and calibrate pressure instruments used and installed in the Saturn space vehicle program under contract being \$1,000,000 from the National Aeronautics and Space Administration.

North American Aviation's Aerospace Division will provide cooperation, engineering support and ground support equipment for the Dyna-Soar space glider's initial guidance system under a contract covering \$1.5 million from Managuard-Hawthorne-Regulator Co.'s Aerospace Division.

High flow at 5,000 PSI pneumatic solenoid valve for aero-space vehicles

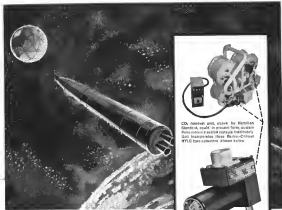
The new Valcor solenoid valve, Series 387, was developed and is currently being qualified especially for the space-age industry's new super models, above high operating altitudes, combined with extreme temperature variations, must be controlled... exactly. A major item of this, while design is in its final stages, the Series 387 has, we believe, the lowest pressure drop of any propeller valve designed for fuel, hydraulic and pneumatic applications. Its control feature allows a high rate of flow at 5000 psi, at temperatures ranging from -45°F to +400°F.

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CO₂ removal unit, shown by Hamilton Standard, would be mounted inside capsule. This carbon dioxide scrubber continuously draws impurities from Barber-Colman NYLC tank, releasing clean air.

fresh air for the "ride" all the way out and back

When long-duration manned space flights begin, astronauts will travel in a craft with interior environment provided by a mechanical life-support system.

This environment must be precisely controlled to provide a constant supply of fresh air throughout the entire mission. An important part will be a reusable CO₂ removal system, such as recently developed by Hamilton Standard Division of United Aircraft Corporation. With it aboard, carbon dioxide exhaled by occupants of the spacecraft is trapped and dumped into space.

Within this CO₂ removal unit, valves are operated by three Barber-Colman NYLC electro-

mechanical actuators, which, along with the entire system, have undergone hundreds of hours of successful testing with a three-man load in Hamilton Standard's "Moon Room." Further tests are also scheduled by NASA.

The NYLC series of actuators has helped reduce weight and size in many other critical applications. Write for bulletins describing this dependable actuator or consult the Barber-Colman engineering sales office nearest you: Baltimore, Boston, Dayton, Fort Worth, Los Angeles, Montreal, New York, Rockford, San Diego, Seattle, Water Park, Pa.

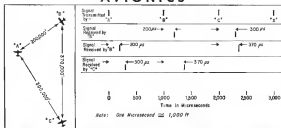


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TIME-REFERENCE technique proposed for anti-collision system calls for equipping aircraft with precision time standard to each one transmit local timing pulse at precisely at assigned time slot. Other aircraft need only determine how long last transmission period to estimate when plane's next pulse will occur and "steer" time. Display shift measurement on electronic clock rate with satellite, and auto in transmitted signal indicates altitude for collision hazard evaluation.

FAA Studies New Anti-Collision Technique

By Philip J. Klein

Washington—Promising new technique for an airborne collision avoidance system, based on use of an airborne precision time reference is being investigated by several companies.

Federal Aviation Agency is expected soon to award a contract to National Co., Malibu, Minn., to conduct feasibility experiments on the new "time-reference" technique. Several other firms, including an aircraft manufacturer, are studying the technique, as Air Transport Data spokesman says.

Flight tests of several previously proposed anti-collision system techniques have recently been completed by the FAA's National Aviation Facilities Experimental Center (NAFEC) at Atlantic City. Tests demonstrated the feasibility of two design concepts and the lack of suitability of another, according to FAA's James Mosier, head of Research & Development Service's collision prevention section.

Here are the results of the FAA tests, and the current status of the anti-collision system techniques.

• **Berlin Radio ground-to-air ranging system**, using the rate of intruder range to closing rate, to determine whether a collision hazard exists demonstrated its basic feasibility in a series of 38 flight tests conducted at NAFEC. (For description of Berlin system, see AW Feb. 15, 1966, p. 67.) The ground-based ranging technique, used to determine distance to an intruder aircraft,

demonstrated satisfactory performance over a variety of ground conditions, disarming doubts that it might not provide the required accuracy. The range technique is implementation of the Berlin system as the fact that it requires a bandwidth of about 15 mc at the 100 to 300 mc portion of the radio spectrum, not now assigned for aviation use and hence crowded with other users. The 370 mc to 390 mc band, assigned to UHF television, is relatively unused at the moment, but the Federal Communications Commission is anxious to expand its use and therefore is not likely to relinquish a 15 mc portion of the band for aviation purposes.

• **Sperry Gyroscope Inc.** has awarded hangar test contract, considered a critical portion of the intruder-free transponder of collision avoidance system which, company has proposed, demonstrated satisfactory accuracy and smooth resolution in a recently concluded FAA flight tests. The agency recently awarded Sperry a \$100,000 contract which and objective is to produce a double prototype prototype warning indicator for flight evaluation early in 1966, and a smaller prototype of an automatic collision avoidance system for flight test early in 1967. The prototype warning indicator will alert the pilot in the presence of an intruding aircraft and display its bearing and possibly its range, whereas the collision avoidance system indicates a computer to evaluate the collision hazard, and to determine the required evasive maneuver direction.

The Sperry system would operate in the K band, around 15,700 mc, where spectrum is available. The hangar test which FAA tested is the heart of the Sperry system. It provides a dual-channel search receiver, antenna and an omnidirectional transponder antenna in a single package and is similar to the unit for Sperry's AN/APN-121 equipment used in US-47 aircraft to locate aerial targets for night-research.

• **Minneapolis-Honeywell** infrared proximity warning indicator, currently undergoing ground tests at the Naval Ordnance Test Station in China Lake, Calif., is scheduled to go to NAFEC this month for flight evaluation. System is a cooperative type which includes both an infrared scanner and a emitting indicator for fully equipped aircraft. The 300-yrk emitting beacon, rotating both infrared and visible light, would replace the previously used rotating beacon. Honeywell hopes that the bearing will get the infrared system improved operating range over a self-contained system which must depend upon mutual infrared radiation from aircraft engines. (For description of Honeywell system principles, see AW Jan. 17, 1966, p. 38.)

• **Motors** proximity warning system, a cooperative type operating at VHF frequencies, proved unsuitable in recent FAA flight tests, according to Mosier. Shortcomings disclosed in the test included excessive bearing detection system and interference from other



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VHF studies, AVIATION WEEK was told. • Ultra-violet proximity warning system, similar to the Blomwell infrared system except that it would use a beam emitting in the ultra violet region, has been ruled out as a result of propagation tests conducted by Thermo Laboratories under FAA contract. It had been proposed that ultra violet might be feasible if the wavelength emitted was adjusted to coincide with that absorbed by the ozone layer of the earth so as to shield the system from solar radiation. But Blomwell's tests indicated that the maximum propagation range was less than six miles and frequently no more than three miles, providing insufficient warning time.

During the current fiscal year, FAA funding of outside research and development in the anti-collision radar field has amounted to approximately \$450,000.

Activities Active

As Transport Area, which spearheaded efforts to develop proximity warning/collision avoidance systems prior to the FAA's tests, over the last several years ago, it can completely satisfied with the priority which the agency has given the program in the past.

The ATA recently has formed a group to study the current status of available techniques and to recommend possible action in its anti-collision radar investigations, which are major suppliers of airframe mission equipment, are participating in the ATA study. They are Boeing, Caltech Radio and Radio Corp. of America.

Collins has devised a digital computer program which it believes can be used to evaluate the effectiveness and false-alarm dangers of different basic anti-collision radar techniques. Through the cooperation of the FAA, magnetic tape records of terminal area traffic control incidents on the large NAFEC simulator will be used as realistic inputs to the computer, together with the characteristics of the particular anti-collision radar under evaluation.

Computer Evaluation

David Collins computer evaluation is being carried out on the Boeing ground-based testing type system. Results are expected to be presented at the next meeting of the ATA anti-collision group in Cedar Rapids, Iowa, scheduled for next May, according to ATA's Frank White. The group also plans to investigate the new time-reference technique and systems based on use of ultrasonic transducers, such as the Sperry system. White says.

Details on the new time-reference type of anti-collision system are directly held by proprietary reasons, but the basic principles can be described. That

of the system would be an airborne, precision time standard, with an accuracy of about one part in one billion (10⁹) or 10 billion (10¹⁰). The common atomic clock, such as one purchased by National Guard and FBI Federal Laboratories, could provide such accuracy, but their weight and cost appear excessive for the application, most obvious here. However, recent progress in systems of extrinsic, stable crystal oscillators suggests that they might provide the required accuracy, if productively re-timed from ground stations.

The technique, known that each aircraft time standard be synchronized with those in all other aircraft to within a fraction of a microsecond (millionth of a second).

To illustrate the principle of operation, assume that each aircraft time is divided into 1,000 millionth increments. Also, that the instant for one aircraft to transmit its anti-collision warning signal, which lasts for only a couple of microseconds, is at the beginning of one of the 1,000 millionth increments. Then the transmission bursts during any second of the day would be 00.001, 00.002, 00.003, 00.001, 01.003, 01.001, 02.001, 02.002, 02.003, etc.

Each engaged aircraft would be assigned a specific time slot during which it, and it alone, will transmit its collision warning signal. For example, aircraft "A" would always transmit in the time slot 00.001, 01.001, 02.001, 03.001, while aircraft "B" would always transmit in the second time slot 00.002, 01.002, 02.002, 03.002.

Aircraft "C" would always transmit in the third slot. Aircraft "D" in the fourth and so on. The timing of each aircraft's transmission would be controlled by its precision airborne time reference.

Assuming that each airborne time standard maintains the required accuracy, a thousand aircraft in a given area could each transmit a collision warning signal once every second, based on the distinctive numbers selected above, but only one aircraft would be transmitting at any instant.

Immediately following each transmission, there would be a period of silence during which a receiver on each aircraft would listen for pulses from other aircraft in the vicinity. When such a pulse is received, the aircraft receiver determines the time interval from the last transmission time slot from which it can establish the distance to the intruding aircraft based on the time required for its signal to reach own aircraft.

For example, if the signal arrives at own aircraft at time 00.001200, it has arrived approximately 200 microseconds after the last transmission time slot assigned to one aircraft. Since each

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• **New Microelectronic Firm—**Melrose Science Corp. will be set up in Menlo Park, Calif., to mass produce integrated semiconductor circuits, also bracing other microelectronic technology, such as thin gate film, as well. James A. Mall, previously with Fairchild Semiconductor Corp. and before that with Diamond Ordnance-Fuel Laboratories will be president. Diamond Semiconductor, another former Fairchild company, will be vice president. Firm is to be financed by Electronic Capital Corp., San Diego, and Universal Microtron Corp., Los Angeles. This will be at least the fifth semiconductor company registered on the San Francisco Bay area within the past 18 months and the third integrated circuit, said former by former Fairchild employees in the same period.

• **Cassanese Shows Microelectronic Innovations—**Commercial scientists are starting to show an interest in microelectronic and microelectronic electronics, as evidenced by recent articles in their open literature, mostly regarding an technology under investigation in the United States. An article in *Foreign Technology* (No. 14, 1981, p. 5) compares Westinghouse Electric work in microelectronics which also is featured in the *San Germano Radio and Forensic* (No. 10, 1980, p. 305).

• **Slide Rule Calculators FEET Time—**Small circular slide rule which can be used to calculate "expected time" from the figures for "optimum," "practical" and "case study" tests, has been developed by James H. Hines of Vortex Associates, Palo Alto, Calif. Part-O-Graph time estimate computer, can be purchased from Vortex for \$150.

• **Sperry Ties Ultimate Beveling—**An advanced beveling machine capable of connecting up to 15 semiconductor components simultaneously is being developed by Sperry Electronic Test Division, Sperry Rand Corp. Machine requires an array of peripheral instruments which operate in 10 sec, allowing the user connecting components against low levels. Visiting machine produces pressures as high as 100 tons per square inch.

• **TV Broadcast by Satellite Utility—**Television broadcasts from satellites directly to individual home TV sets appear increasingly imminent and rich in content. The technology for the satellite, according to an engineering method made in Stanford Research Institute under sponsorship of National Aeronautics and Space Administration. Assuming the average TV set over

SPERRY LUKENS has entered test of the company's proposed anti-collision system, installed on Federal Aviation Agency C-131, all of one oblique door. The computer type system would use interrogator and responder in each equipped aircraft to exchange information on such aspects as heading, speed and altitude. Lower portion of the antenna is considered for responder use, while the other may contain a directional receiving antenna for interrogator use in determining the intruder's heading.

where travel approximately 1,000 ft in one microsecond, the anti-collision aircraft whose signal arrives at 00:00:1200 is roughly 200,000 ft away from own aircraft. The target time would also be 200 microseconds, and an intruder would be 200,000 ft away, if its signal arrives at time 00:00:1210, 01:00:1200, or 50:19:0100. The system would not keep a catalog of intruder times assigned to each aircraft but the ability of the intruder is not important for its collision program.

If there is another aircraft within line-of-sight range of own aircraft, its signal would be received after its assigned transmission time due. The received signal in addition to providing information on intruder range (distance) a Doppler shift due to the relative velocities between the two aircraft. By comparing the frequency of the received signal with the reference frequency, and as a true calculation, this Doppler shift can be calculated and converted into relative true rate.

The ratio of intruder range to its closing rate provides the same collision hazard indication system which is used, and has been tested, in the Boeing ground-based radar system.

Only one other type of information is required—the "intruder's" altitude of the intruder. This can be obtained of each aircraft's transponder signal, instead of one, using a code which indicates the aircraft's altitude.

Present thinking is that the roll-out of the ratio of intruder range to its closing rate provides the same collision hazard indication system which is used, and has been tested, in the Boeing ground-based radar system.

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internal between successive transmission by an individual aircraft would be about 100 to 150 sec, to avoid range determination ambiguities.

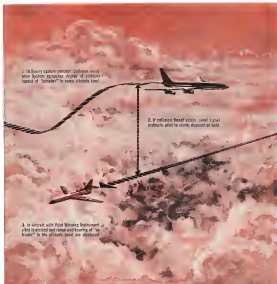
The new technique may offer an important advantage over the ground-based ranging system, in addition to being able to operate in the available portions of the radio spectrum. A single signal arriving at own aircraft may provide sufficiently accurate data on intruder range and closing rate, whereas the ground-based ranging technique requires up to 30 sec of averaging of received signal to obtain usable data, reducing counter measures time.

The close synchronization required of all aircraft line standards appears possible by means of use of one of several precision techniques for portable microelectronic time ground stations, according to Hines.

An attractive by-product feature of the new time standard technique is the possibility that it might find use in a traffic control/navigation system.

If signal travel time is measured from an interrogator, instead of an aircraft, by there is some ground stations and transmission is used, the ground stations can precisely determine the position and altitude of each aircraft.

Several mobile concepts of traffic control systems based on position information from a network of ground stations have been incorporated in several companies in the past including International Business Machines Corp., Lockheed and Thompson-Rasse Worldwide.



COLLISION PREVENTION: A PROGRESS REPORT

Culminating many years of research in collision avoidance, Sperry is currently making a feasibility study of intercept or transponder techniques under FAA contract. This involves design studies and evaluation of experimental equipment (such as the Sperry-designed Pilot Warning Instrument, Collision Avoidance System and Minimum Transponder System). Flight evaluation of a Sperry designed Loran-B less intense has

been completed with highly successful results, including demonstration of its ability to provide usable contrast for use in a Collision Avoidance System which is operational at all altitudes and under all weather conditions.

Under another contract, Sperry is conducting a no model study in which pilots will experience 24,000 "near misses" in flight simulation—in order to test human and other factors. These

tests are being conducted at NAFPC in Atlantic City.

If the feasibility of collision prevention is demonstrated utilizing these techniques, Sperry believes that the lead time to an operational system can be reduced significantly.

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was willing to go to the trouble and expense of installing a 30 ft diameter parabolic antenna, a direct-broadcast TV satellite as a transmission (showing 75,000-watt output would require 300 to 400 kw of electric power for its transmitter alone, SRI's Richard G. Gould reported at the recent Institute of Radio Engineers convention). Considering the problems of direct-broadcast TV transmission standards, language and local time in the large area which would be covered by such a satellite, Gould concluded that there is little justification for such an approach in comparison with use of satellites for TV relay between regular ground stations and/or between broadcast using relay type.

• Signed on the dotted line—Major contract awards recently announced by various manufacturers include:

• **Philco Corp.**, Palo Alto, Calif., \$5.5 million Air Force contract for production of satellites, control subsystems.

• **General Electric**, Syracuse, N.Y., \$1.5 million USAF supplemental contract for research and development of airborne guidance equipment in support of space programs.

• **Collins Radio Co.**, Cedar Rapids, Iowa, Hamilton Air Force contract for production of communication system components.

• **Systems Development Corp.**, Santa Monica, Calif., \$344 million supplemental USAF contract for development, acquisition and installation of voice training program for Air Defense Command manual and semi-automatic ground environment (SAGE) defense system.

• **General Dynamics Corp.**, \$7.6 million Air Force Ballistic Systems Division contract for communication system at three Titan ICBM bases and a training facility. Systems, produced by General Dynamics Telecommunications, Rutherford, N.Y., will go in at Dover Air Force, McConnell, Little Rock and Vandenberg AFB.

• **General Atomics Corp.**, Philadelphia, \$50,000 award from Office of Naval Research for investigation of techniques for detection and classification of objects in space.

• **Armstrong Corp.** of Astoria, Milwaukee, \$1.5 million Air Force contract for location location indicators.

• **International Business Machines Corp.**, will provide four IBM 1410 calculator data processing systems to Defense Department for its Defense Communications System. One of the systems will be installed at each of four new communication control centers in Europe, Alaska, Hawaii and Colorado, to display warning status report on communication circuits and to feed such information to the Defense National Communications Control Center west Washington.



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Magnetic Flux Pump May Provide Shield Against Cosmic Radiation

Washington—New type of capacitor during device for producing large magnetic fields, called a "flux pump," which may find use for shielding space vehicle occupants from cosmic radiation, for control of plasma currents on the magnetic confinement of plasmas in thermonuclear power generation, was disclosed here during the recent meeting of the American Physical Society.

Scientists from the Jet Propulsion Laboratory reported that an experimental mechanical flux pump tested had increased the magnetic field in a magnetron cylinder from its initial value of 1,600 oersteds to 23,600 oer-

stedes. (Note "oersted" and "gauss" are equal and interchangeable.)

A similar device, described by scientists from General Electric's Research Laboratories, has action of magnetic fields up to 17,000 oersteds and fields of 20,000 to 25,000 oersteds are currently attainable (they said). Both devices were operated approximately at the temperature of liquid helium (4.2 Kelvin). The new flux pump consists of a cylinder of superconducting material with a large center core and an enclosing coil of smaller diameter, with a seal, connecting the two centers.

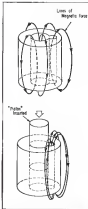
The superconducting material is exposed to an external field, then cooled in liquid helium temperature, which forces the magnetic flux in the material and the external magnetic field can then be removed. This flux is distributed around the circumference of the cylinder, as shown in the sketch.

If a rod of similar superconducting material is then inserted into the large center core, the flux can not penetrate the rod at the superconductive temperature and is forced through the neck into the smaller core, producing a more intense magnetic field in this region.

The JPL scientists also described an electric flux valve which they devised to control the return flow of magnetic flux, to produce an electric flux pump. A similar block of superconducting material was used except that the two centers were not connected by the small neck. Instead a small electric heater is embedded in the neck of the block between the two centers. When a current is passed through the heater, the neck between the two centers becomes non-superconducting and the flux, previously locked from one center to the other. When the current is removed, the material again becomes superconducting and the valve is in effect, closed.

When a similar heater was embedded in the outer wall of the superconducting material and the two heater alternately was supplied with current (connected with a cycle time of about 80 sec.) a pumping action resulted. Field strength of 3,600 oersted external field of the vacuum vessel used was attained after 25 cycles.

Using other materials with higher critical field values, it should be possible to electrically pump up fields of approximately 100,000 oersteds, or values large enough to contain a plasma or a mirror or shield chamber the JPL scientists predicted. If the pump is operated in reverse, it can produce a "magnetic vacuum," with fields as low as 0.0001 oersted, it was reported.



SUPERCONDUCTING FLUX PUMP. New principle is eight-pole magnetic shield to protect space vehicle from cosmic radiation. Cylinder of superconducting material with two connected cavities (top sketch) has magnetic field established. Then a coil of superconducting material is inserted in outer cavity (bottom sketch), which forces flux into smaller cavity to produce higher field concentration.



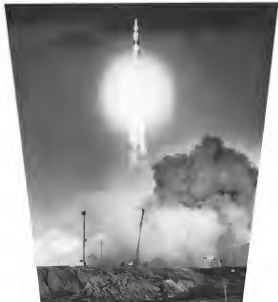
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Martin Company, the aerospace division of Martin Marietta, designed and built Titan for the U. S. Air Force and is the integrating contractor for Titan hardbases.



Antenna Technique

Delta loading, new technique for making precision, rigid antenna reflectors, is less costly than wire processes and ensures that reflector will maintain original shape, according to General Electric's Delmarco DePalma who developed the technique. The sheet of last tested 4081 series sheet was a constant duty large vertical beam, still controlled from trajectory.

GE Develops Oxygen Detection Sensor

New York-Patent expires soon, based on the principles of the hydrogen oxygen fuel cell has been developed by General Electric's Missile and Space Vehicle Dept. to detect low or high oxygen levels in a manned space capsule.

Configuration of the sensor is similar to conventional ion exchange membrane-type fuel cells, with the exception that the entire internal volume of the capsule—through which the oxygen circulation is substituted for a separate oxygen chamber.

A porous hydroxide membrane sandwiched between two platinum electrodes separates the hydrogen chamber from the oxygen chamber. Reaction of the oxygen and hydrogen to the catalytic membrane generates water and electrical current, measured in milliamps and read out on a radioisotope on the manned space capsule's instrument panel.



Cryogenic Gyro

Cryogenic gas, being developed by General Electric's Ordnance Dept., is shown disassembled into four major components: upper and lower bearings, spherical carbon fiber (loaders) and optical mirror pick-off.

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Automatic Photo Printer Removes Distortions From Aerial Pictures

Lexington, Mass.—EN-71 Rectifying Printer incorporating variable mechanical bearings has been developed by Tel Laboratories Inc. to print battlefield reconnaissance photos taken by the Army's USD-5 drone aircraft.

The printer's optical design enables it to print on a uniform scale 70 mm film exposed by a panoramic camera on a constantly changing scale from horizon to horizon.

Photo interpretation that can recognize ground objects in the photos accurately without the need to use laboratory procedures which produce uncertain projection on remote targets.

The EN-71 was produced by Tel for the Army Signal Corps Research and Development Laboratory. The camera which will take the photos from the USD-5 is still under development. In operational use, the USD-5 will produce battlefield photography constant at altitudes from 1,000 to 2,000 ft.

The EN-71 is self-contained. Prints are made on 5-in wide photosensitive film or paper used in roll form. Although ordinarily intended for daylight darkness exposures, it can be stored under sunlight conditions for extremely long periods without endangering the photo-sensitive material.

The printer compensates for three types of distortion—panoramic scan position and that caused by the standard image motion compensator.

The EN-71 rectifies the distorted images in the negative film by proportionally increasing all distortion values across the photographic system.

The printer's light source is on a disc-shaped lamp housing. The housing is movable, describing an arc around a plate on which the film rests. The light projects the image through a lens to the end. The plates and end move to compensate for roll, yaw, ground movement, and so on, during the film exposure by lens actuating and image motion actions. These latter related actions are adaptable according to the light's velocity, direction and distance conditions.

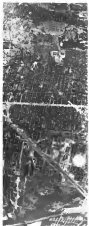
Corner shape of the end eliminates panoramic distortion in the film. The constant varies the ratio of the object-image distance, and consequently, the magnification, from about 7:1 straight down to about 4:1 at extreme side levels.

End movements proportionately duplicate ground displacement caused by aircraft movement during the scan

period. A roll and undistortion lens analog supply movements in square.

Flare motion compensates for the image motion compensator distortion resulting from movement of the camera lens and focal plane. The photo motion varies as the sine of the scan angle in the direction opposite the end.

The EN-71 is designed to be particularly flexible in field service use in a trailer, if cleanliness and power supplies are within prescribed limits. The camera now under development for the USD-5 and the EN-71 is planned to be applicable also to manned aircraft.



COMPARISON of unrectified (left) and rectified panoramic exposures shows different made by Tel EN-71 Rectifying Printer. Unrectified print shows image distortions caused by focal plane geometry, imaging action of the lens, vehicle forward displacement during scan and lens to focal plane motion used to compensate for image motion. EN-71 causes distortion through use of variable mechanical bearings. System produced by Army Signal Corps Research and Development Laboratory, may be used with manned aircraft as well as drones.



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AERO COMMANDER 112 Executive jet C119
VOIGHT V10L Military transport T64-6
MCDONNELL F-104 A-7 Fighter 100-0
HUGHES 119C Navy ship 110
ALASKA CARRIER Transport-Flight 104-4



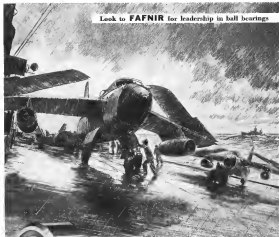
BOEING VERTOL 107 Heavy transport 105
P-51 MUSTANG Executive jet C105
LOCKHEED F-105 Fighter C105
MCDONNELL F-4 Fighter C105
HUGHES 119C Navy ship 110
MCDONNELL F-104 Army VTC-10 100-0
HUGHES 119C Executive jet C119

SMALL AIRCRAFT SHOW DEPARTMENT

GENERAL ELECTRIC

FLIGHT PROPULSION DIVISION

1967



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Sea duty can be hard on aircraft control bearings. Rust is a constant hazard. To solve the problem, Fafnir makes ball bearings with built-in "Sea/Weather" — tight-fitting seals that keep weather and salt spray out. In use in exposed locations, these bearings help keep the wings of the fleet poised for flight. For leadership in ball bearings... look to Fafnir. The Fafnir Bearing Company, New Britain, Connecticut.

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1/10,000-Lb.-Thrust Rocket

Confined jet pulsed plasma accelerators, designed primarily for use in attitude control of spaceborne satellites, is used to deliver 1/10,000 lb. average thrust at one pulse per second, with a specific impulse of 5,000 sec.

The manufacturer reports 50% efficiency for the Model A-164-2 rocket which operates on 22 v. Watts is used as the propellant. The unit consists of two chambers mounted on a single oscillator to produce two-directional thrust.

The motor unit is 52 in. high, and overall length of the two chambers is 24 in. Weight is under 7 lb.

Rocket Research Corp., 251 S. 14th Ave. St., Seattle 5, Wash.



Portable Oxygen System

Sutro, designated Scott Executive Mark 2 is used to be effective from sea level to 30,000 ft. The unit can be uprated, installed in flight for use, attach up to its maximum rating.

The system has a rated duration of 7 hr. 30 min. at 10,000 ft., 4 hr. at 30,000 ft. for use by one person. Unit weight is 12 lb. The system also is available with a notebook holder to eliminate need for a permanent battery.

Scott Aviation Corp., Department D-52, Lancaster, N. Y.

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BEAGLE AIREDALE business aircraft has high visibility, wide top fuselage window aft of passenger compartment.

Aviation Week Pilot Report:

Airedale Production to Be Accelerated

By Herbert J. Coleman

London-Britain's newest lightplane, the four-place Beagle Airedale—a long-wing airplane with excellent handling characteristics at extremely low speeds—has just a few more to be built.

The Airedale, along with the smaller Beagle Trainer 54-2, is the kind of what Beagle Aircraft, Ltd., plans as an executive and sports line emerging from the Beagle 206 twin (AWN No. 12, p. 364) to the lower-priced Beagle/Miles 218 twin and 117 single-engine derivative and the Beagle Wallis Mustang.

At the moment, Beagle is anxious to bring on the Airedale for their reasons:

- Sales and service backlog for the Airedale, still in the formative stages, will be cleared through for the entire line.
- Beagle technical and production staff is working on acquiring the licensing to use more engines now on the Sheshaan production line.

- Beagle 206 is not yet ready for production and Sheshaan is just being tested for the Beagle Miles 218. The single engine 117 version probably will not be built this year, although Beagle hopes to have the 218 made for display at the annual Farnborough Air Show in September.

Second, Beagle 206 is now being finished and incorporates a number of changes from the prototype. Wing has been lengthened and the cabin widened. In addition, hydraulic actuator has been added for easy entry and exit.

The company itself is in no great rush to enter the world market—at least, not this year and probably not the fall. Peter Musfield, Beagle's managing director, said Beagle will not sell its airplanes overseas until a strong dealer/distributor network, backed up by ample spares, can be put into operation.

This is the responsibility of Wing City T. A. Vigon, who directs and fronts Piper dealers for the United Kingdom. In Great Britain, where sales of four-seater aircraft are estimated to be around 100 per year, Vigon is negotiating for 112 distributorships to give what he calls a "solid home base" for Beagle products.

Vigon is convinced that in five years Beagle will be a major world competitor in the lightplane field, comparable to the United States' Big Three: Cessna, Grumman and Piper. At that time, he estimates 80% of Beagle's total output will be export sales. From, headed by Test Pilot Ronald Porteus, has just concluded an Airedale sales campaign which Porteus called "encouraging."

As Vigon puts it, Beagle plans to avoid a "flood" of airplanes to enter into the standard size of the United Kingdom until the sales-service network is well established.

In line with the aim at overseas export sales, the entire Beagle line will be tested in various climatic regions. The Airedale, for instance, has a cooling system designed for tropical operations and one airplane will be sent to Africa for a test program.

Musfield's first Sheshaan production schedule calls for completion of 60 Airedales and 60 Trainers this year. First 30 Airedales have been sold, he said. Plans to move production facilities to de Havilland's Chesham plant, which will be closed in July, have been dropped (AWN April 30, p. 78) and Beagle is now expanding Sheshaan to 51 in future needs.

The Airedale, which is comparable with the Cessna 175, is priced at \$14,500 with full extra package. This is about \$1,000 more than arranged when the airplane first rolled out a year ago and the hike has been attributed to unforeseen production costs. Airplane received a full air transport certificate on last April 16.

Pilot characteristics of the completed Airedale were sampled by this



COCKPIT of Beagle Airedale was designed by pilots for quick instrument reference and visibility. Thrustle, propeller and engine controls are on center console, with instrument panel low at instrument belt. Engine instruments are stacked vertically above the throttle, leaving panel free for flight instruments on left and navigation package on right.

Aviation Week pilot on two flights at White Waltham, one with David Harman of the Beagle flight test section, and the other with Test Pilot Porteus, who did most of the preproduction test flying.

In general, the Airedale is a pilot's airplane, with the cockpit laid out to bring the wide degree of visibility and comfort. Instrument arrangements reflect the automobile experience of Beagle's parent, Pressed Steel Co., Ltd., particularly in seat arrangement and upholstery, both admirably designed to appeal to women.

Beagle also has spent considerable research time in cutting the weight down, with success, though both sound-proofing and sealing of the Leaning O-360 AIA horizontally opposed, four-cylinder engine. Powerplant delivers 150 hp at 2,700 rpm. McCauley propeller is fully controllable from the cockpit.

Stock Appearance

Sleek tail and high visibility cockpit give the airplane a stock appearance, somewhat marred by the external wall for running aft of the engine under which the cabin. Steps on landing gear make entry quite easy, starboard door is fitted for pilots, and rear door is installed on port side for passengers. Handwritten is 57 in. from seat level to cabin roof.

Visibility, both far and near, is excellent and leftmost pilot can see well behind him in level flight. High wing configuration is, of course, con-

ducive to some blindness in the rear, but this is counteracted because the pilot has a Perspex window out into the rear to offset this.

Starting is simple, since pilot needs power engine, with two run-throughs of the throttle, switches on master battery. On both Avianor Wras, flights, the Leaning locked only once, directly with oil pressure and tem-

perature going quickly into the green.

White Waltham is a grass field and bumpy in spots, thus offering an opportunity to evaluate flying a high-wing airplane in a 70 kt-plus wind. Airedale was quite responsive, even with wind as following quarters. Nine miles a streamer through 10 deg. and two psi data indicates need for 100 psi more on higher speeds. Forward visibility is vastly improved by lifting the top of



AIREDALE ENGINE, a Leaning O-360 AIA of 150 hp, is only accessible through cowl on shown. Firing mechanism for powerplant lowers right waffle.

Second Generation!

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Truly a "second generation" equipment, the AVQ-70 contains complete provisions for doub-

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the instrument panel to the horizon, rather than curved panel found on vintage type airplanes.

Arrived, down was registered GARDX and held 30 loop gals of fuel at 14,000 ft. Tanks are installed in rear end of the wings (15 loop gals each) and fuel is gravity fed from tanks to a selector valve on the floor beneath the pilot. Beagle is offering two additional tanks of 10 loop gals each as optional equipment, both are located on third of the existing wing tanks.

Takoff at 4300, 1000 ft. was at full throttle and full rpm with wind gusting to 20 kt from 210 deg. Power to 14000 ft. propeller was run through its cycle once and each cylinder checked at 2500 rpm. Drop in 1000 ft. to 125 rpm. Takoff was made with 15 deg. flaps and nose wheel at about 40 mph. Initial climbout was at 65 mph, building to 78 mph after flaps were raised. For a rate of climb of about 500 fpm. Angle of climb is fairly steep, but not unpleasant.

Beagle suggests full throttle, full rpm climb to 2000 ft., when power can be limited off 3/4 per theoretical fuel and mixture based on "brake" rpm, at 1900 ft. High cruise is 72.5 in hg. and 2500 rpm, for a indicated speed of about 115 kt. Fuel consumption at this power setting worked out to about 9.5 gal per hour. Forward cruise set at 22 in hg. and 2400 rpm, indicated fuel consumption is about 8.5 gph.

With its low noise level and wide range of visibility, the Avardale is easy to fly, and most responses to altitude control, due to wide surfaces provided in steep turn, beyond 30 deg. control is quite simple and altitude is maintained by slightly more than three second back pressure. Arrivals or descents from altitudes but in high performance maneuvers showed no abnormal characteristics.

However, in a full, power-off stall, the Avardale tends to drop off sharply, on the left wing into a steeply defined dive. Warning is quite obvious, both through nose buffeting and stall warning horn, and recovery is quick, in this case, we lost less than 10 ft. before returning level flight.

In line with Beagle philosophy, for as much flight safety as can be built in, the Avardale has good stall characteristics, a full flap, power off stall occurs at 17 kt. TAS, and a flap up stall at 45 kt. TAS.

Avardale can be flown quite easily at near stall speeds, as Portier demonstrated by holding nose up on a flat taxi and making a 360 ft. turn, without on the heels of the stall, we have had the Avardale tend to get over the pilot.

On landing, the Avardale is flown on the basic leg at 65 kt with 15 deg. of flap down. Turning in final, full flap is lowered and approach speed cut to 50-55 kt depending on wind conditions. This gives a fairly steep angle of glide but

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The Fearn Manufacturing Company, Newington, Connecticut.

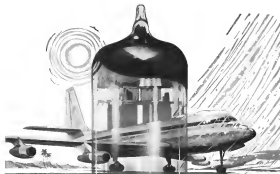
Aerospace Products Division



U.S. Business & Utility Aircraft Shipments

February 1962

	Make & Model	No. of Units	Total Shipments
Aero Commander	440 B	5	\$1,015,000
	440 C	1	
	440 D	2	
Beagle C-130	210	1	\$7,500,000
	210A	30	
	210B	30	
	210C	1	
	210D	1	
	210E	1	
	210F	1	
Cessna 440	440	1	\$1,015,000
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Cessna 440	440	1	\$1,015,000
	440A	1	
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Cessna 440	440	1	\$1,015,000
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Cessna 440	440	1	\$1,015,000
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	440F	1	
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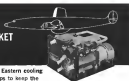
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FINANCIAL Battle Goes on Over Hughes' TWA Control

By William H. Gregory

New York—Any attempt Howard Hughes might make to sue his stock in Hughes Tool Co. to obtain relief from back control of Trans World Airlines appears to be blocked for the moment in a Delaware Chancery court order which acquiesces the stock.

The acquiescence does not require physical possession of the stock. The legal mechanics were fulfilled when the court-appointed liquidator, Jacob Kischel, a Wilmington lawyer, served notice of the order on the Delaware resident agent for Hughes Tool, the United States Corporation Co. of Dover Del. The agent is John Arthur Hughes Tool.

While the order is in effect, any transfer of the stock as a gift would be voided. Speculations also effectively eliminate the use of the stock as security for a loan, for a bank would be unable to transfer the stock in foreclosure. Hughes has used the stock for collateral personally.

TWA obtained the order in connection with a \$55-million damage suit filed against Hughes in the Delaware court (AW Apr. 23, p. 42). The request, the TWA suit said, was sought to compel an appearance by Hughes, but the step also fits a petteen as the 23-year slambang between Hughes and control for TWA control.

Last summer TWA filed an antitrust suit in New York against Hughes alleging his control of control of the airline through 78% of TWA stock owned by Hughes Tool resulted in damage to competitors and other charges in the airline (AW Apr. 14, p. 47). Though TWA's objective at that time was to prevent interference by Hughes in TWA's reorganization for Boeing 707's which has been completed, a special first class construction of directors was appointed to review the litigation and decided to proceed with it.

Hughes has since filed an answer and counterclaim to the TWA suit, charging in the latter a conspiracy to gain and maintain control of TWA by Ernest R. Borelli, chairman of the TWA board; Ben Fleming Scott, TWA board member and senior vice president of Irving Trust Co.; Dillon, Read & Co., underwriter of TWA's reorganization program; and two insurance companies—Equitable Life Assurance Society and Metropolitan Life Insurance Co.

The Hughes counterclaim gives the most detailed account so far from the

Hughes standpoint of the two-year negotiations for financing only in the here that the Hughes stock be placed in a lender-controlled voting trust. In turn, the TWA suit filed in Delaware adds more additional details of the creation of the trust, which Hughes took in and by court order in the proceedings. The foundation was laid for the dispute, Hughes disavowed alleges, when given to 1956 lending institutions, including Metropolitan and Equitable, agreed to loan.

Such lending institutions would not supply financing to an airline without control of the traditional senior lender to the airline.

Rebel in the senior lender to supply could exempt an particular terms would mean none of the others would be so either except on the same terms.

Then the class controls, Equitable's support as traditional senior lender was a security for getting together TWA's reorganization program. Hughes Tool, in fact, disavowed with Equitable in 1958 what Equitable's requirements would be for such financing. Among them, the firm said, was creation of a lender-controlled voting trust, but only in the event of a TWA default.

Hughes Tool considered the disavowal unacceptable, generally because Equitable opposed anything in particular as permanent financing unless

Hughes Tool assumed substantial permanent obligations.

Dillon, Read was retained in early 1958 to prepare a financing plan, but in view of Equitable's lack of support and the dire prospects for any equity financing, a lending plan was developed. This was rejected, however, by TWA, since Equitable would not support it.

By then financing had begun to falter. TWA's first 707 jet transports, following public acceptance of jets would crash. TWA to finance its jet program independently, Hughes Tool began to consider the possibility of a loan. When Hughes Tool's own cash position was virtually exhausted, additional equity was financed in loans from Irving Trust, looking back for both TWA and Hughes Tool, and from other banks could make in 1960.

Irving Trust advised Hughes Tool in 1958 that Hughes Tool had exhausted its legal line limit and that Irving Trust's consent could not be required for subsequent loans. Hughes Tool requested Irving Trust to terminate such previous credit without giving Hughes Tool adequate time to arrange other in terms credit or permanent jet financing.

When Equitable had refused to support the Irving plan, Hughes had turned to manufacturers for assistance in financing existing jet orders, and also additional planned—presumably Convair 440's also in order by TWA. The Hughes claim and Irving Trust learned



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only in 1960 of the negotiations with manufacturers and on May 3 Irving Froy and the other banks advised Hughes Tool that they would supply no more short-term credit for further aircraft deliveries. Equitable, which had the right under existing TWA financing for private aircraft to prevent credit payments owed Hughes Tool by TWA from being paid, refused to permit such payments. These, the Hughes claim was, would have given it an alternative source of funds to pay for aircraft.

Dillon, Read Plan

Facing mounting financial problems, Hughes Tool and TWA agreed to represent, in March, 1960, what became known as the Dillon Read plan. It called for Equitable and other insurance companies to provide some long-term financing, Irving and associated banks short-term money and Hughes Tool to accept \$100 million in subordinated TWA debt in payment for TWA's obligations.

Among Equitable's stipulations for participation was one that was to trigger automatic workouts later. In the event of certain defaults and reaching a default in the result of a management change, the Hughes TWA stock was to be placed in a voting trust, the Hughes claim continued.

Relying on Dillon, Read's plan, that no alternative credit, Hughes Tool and it accepted the plan Mar. 25.

TWA's Delaware suit gives a somewhat different version of the birth of the Dillon Read plan. Hughes, the TWA suit says, used Dillon Read, Lehman Bros., and Lazard Freres & Co., all investment banking firms, in February, 1959, to devise financing. Two separate plans were prepared for TWA's and Hughes' consideration by the following month.

Plan 1 was similar to what became known as the Dillon, Read plan. Plan 2 was the leasing plan, which called for creation of a leasing company, the Hughes Aircraft Leasing Co. in Edison.

Holm says to be a wholly owned subsidiary of Hughes Tool and would lease the Boeing 707s ordered by Hughes Tool to TWA with option to purchase and would borrow the funds to pay for the airplanes from banks and insurance companies.

Equitable rejected the plan the TWA suit says, on the ground that Holm would be a mere shell whose earnings would be dependent on TWA's upon whose credit the transaction rested. In addition, the suit and TWA executives opposed the plan because it depicted TWA's ownership of the airplanes and the substantial fee advantages which existed from such ownership and because it would increase the total eventual aircraft cost to TWA.

Despite this opposition, Hughes ob-



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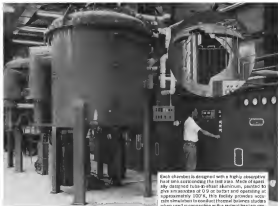
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based various revisions of the basic plan over the next few months in an attempt to reconcile the interests of Hughes and the lenders. Principal obstacle to a successful basic plan: the TWA test delays, was Hughes' dream for a plan providing him with a substantial capital gain profit and other test advantages.

On April 13, Hughes fixed the number of aircraft to be financed in one TWA package at 20 Cessna 440s, 10 fewer than originally ordered by Hughes, 10 Boeing 707-311s 5 fewer than first ordered, and 15 Boeing 707-311s, 5 fewer than ordered. Revisions of the basic plan on this have continued through May, with Hughes seeking a plan based on fixed assets other than aircraft contingent on savings, the suit said.

Boeing had been pressing Hughes to arrange financing during the spring and Hughes, to avoid default on Boeing, said on Boeing 707-311s to its principal transferee companies, Pan American World Airways, on June 10, the TWA suit asserted.

In July, the TWA suit said, Hughes abandoned any attempt to arrange permanent financing, and turned to short-term bank loans and stay put amounts to meet payments for 707s. This approach guaranteed, through the end of 1975 and until March, 1980.

Some TWA officers or directors on duty felt the advice forced a crisis by the end of March for the TWA suit claims that the TWA board of directors, at a Hughes advanced meeting that extended over several days, approved the Dillon, Read plan in spite of the objections of Hughes. Faced with this step, Hughes agreed on May 29 to the plan. But the TWA suit said Hughes announced determined to protect its investments at all costs.

One of the early post-agreement disputes, the Hughes representatives said, arose over the location of reconstruction. Prior to acquisition of the Dillon, Read plan the Hughes does want said, Dillon, Read advised Hughes Tool that interest rates in the permanent bank financing would be 6 1/2%.

Furthermore, the Hughes claim continued, Sewell, on behalf of Irving Trust, told TWA and Hughes Tool that setting of a rate would have to await formation of a banking group, but that there would be full opportunity to negotiate interest levels.

Metropolitan then passed the lending group. Metropolitan and Equitable agreed on an interest rate of 6 1/2%, and Irving Trust and its banking group decided on a rate of 6% for the short-term loans. Not only was the interest rate company 6 1/2% rate higher than that Equitable charged any other company in 1961, the Hughes claim alleged, but Dillon, Read and Irving

consulted from Hughes Tool that other commercial banks were willing to participate in the bank financing on more favorable terms.

In May Metropolitan, Equitable and the banks consulted themselves to the Dillon, Read plan, but under conditions permitting them to withdraw in event of a TWA management change.

TWA's President

TWA's president then was Charles S. Thomas, former secretary of the New York Times to Hughes. The Hughes document alleged, Thomas had told Dillon, Read and other lenders that he intended to ensure a profitable and at a substantial return on investment and provide for a lifetime retirement as well. None of the lenders told Hughes of the secretary of Thomas' terms, he then said, until after Hughes Tool had committed itself to the Dillon, Read plan.

Closing of the financing, originally scheduled for May 31, then postponed to June 27, expired again to July 27.

The TWA suit says a default to the grace of dates. It said the closing was originally set for June 30, was changed first to July 14 and then to July 28 before slipping finally to July 29. Interest, \$40 million bank loans made under the TWA suit, were extended until Aug. 1 after the closing.

Prior to the July closing, but after Hughes Tool committed itself to the Dillon, Read plan, the Hughes document alleged, Thomas, for the first time demanded an effort to reorganize the debt increase and a \$38 million in new retirement money. Hughes Tool refused to approve TWA's acceptance, only promise of the financing, but when Thomas, dependent on Charles S. Thomas, the Hughes document said, needed his demand be met by TWA and was supported by the prospective lenders.

Two days before the July 29 closing, Hughes Tool informed the lending group that Thomas had finished the two years of review to which he was committed and intended to reject the Hughes Tool financing proposal. It alleged that the financing group ahead as planned on the understanding that if a permanent loan was not made by the bank group, the loan would be paid in 30 days Hughes Tool would place its own in the underwritten closing term.

According to the Hughes document, representatives of Metropolitan and Equitable had previously approved the proposal. But, the document alleged, James F. Glavin, Jr., president of Equitable, and Elmer C. Hagerty, at the time vice chairman of Metropolitan, together made the decision of the lending group to reject the proposal. Glavin and Hagerty also are named as defendants to the counterclaim. Both also are

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Thomas not to accept a compromise with Hughes Tool that, subsequently appeared, probably, the Hughes document and, but in stage missed.

Thomas did not interpret this step as an adverse change in TWA's management, the leaders verified their right to control the investment loss movements. They agreed to proceed with the Dillon, Read plan by Sept 1 only if Hughes Tool stock was placed as voting trust prior to that date. Hughes Tool's proposal to restructure a partnership satisfactory to the leaders was rejected and in some several times put forward by Hughes, the counter claim lost.

As to Thomas, the TWA had again said further details and offers in various points with the Hughes document. Thomas, the fifth president of TWA in 1956, joined TWA in 1938 on a salary basis. But, the TWA said he had no understanding with Hughes that if he were satisfied with TWA and TWA with him at the end of two years a contract would be negotiated which, in general, would provide for capital gain to Thomas.

Contract Discussion

As early as April, the TWA said that Thomas, said with Hughes on the representation of the question of financing contract terms. Hughes, the TWA said, alleged, refused to negotiate in good faith with Thomas because of the TWA board's action in March approving a financing plan to which Hughes was opposed.

"It was not until early July," the TWA said, continued, "that Thomas was permitted to discuss with Hughes by telephone his personal situation: a disagreement contract which contract not award the amount of investment compensation sought by Thomas but rather upon Hughes' statement refusal to continue Thomas in TWA's chief executive office and to further invest since that Thomas became an employee of TWA (Hughes Tool) instead of TWA, as that Hughes could enforce absolute obedience to his wishes."

The leaders, however, the deprecated Hughes of the importance of making agreement with Thomas in light of the management clause, the TWA said, but Hughes held firm. It was this controversy that had caused postponement of the closing to July 25.

With Thomas resignation, the leading institutions refused to provide the financing unless the voting trust was established. Dillon, Read, however, advised Hughes he must still avoid the voting trust if a new of status, clearly independent of Hughes, was named TWA president at once. No such man satisfactory to the leading institutions was produced. The TWA said, Hughes meeting that any TWA pre-

dent be "my man, both, stock and bond."

The leading institutions kept the financing offer open until Aug 31 on the voting trust basis. When Hughes took no action in agree to it, the banks called the status loan and declared TWA in default.

At the beginning of August, Hughes appeared to believe he faced a difficult but not catastrophic situation. TWA, along all of the banks, badly needed the Hughes-ordered, \$300 million investment, improving jet services. But there still seemed to be a chance to develop an alternative financing plan.

According to the Hughes document, plans were asked to formulate a same plan not requiring a voting trust, and Serel agreed to try. During August and September, the counterclaim said, Irving told Hughes Tool it was attempting to do so, but understanding in previous Hughes Tool to participate in negotiations that were undertaken. Irving's action, the Hughes document said, induced Hughes Tool not to attempt to secure financing itself for TWA, which, the Hughes document alleged, Irving refused to permit several banks not part of the leading group to participate in alternative financing, even though these banks were understood to be willing to do so.

Irving on Sept 15 indicated to Hughes Tool a plan which came to be known as the Bankers' Plan. It provided for General Dynamics Corp., subsidiaries of the General Electric, to participate with \$40 million in equity. "But," the Hughes document said, "as Irving knew at that time he knew, General Dynamics did not have the visible resources to extend a \$40 million credit."

General Dynamics sought the support of Prudential, its major lender, in supplying the \$40 million. Prudential, after consulting with the bank or some of the Dillon, Read group, the counterclaim said, refused and Hughes Tool then arranged to release General Dynamics of all of its obligation by liquidation of \$30 million in assets not related to TWA. These assets were not specified, but there was still a Wall Street at that time that Hughes was considering the public sale of stock other in Hughes Tool or in Hughes Aircraft.

In any event, the crisis was disappearing for Hughes, and the specific of ownership being over the nature of financing was not forthcoming. To prevent the delivery of stock more further during the TWA, Hughes agreed to the Bankers' Plan, in modified, and Irving and the banking group met Oct 5 to consider the plan.

According to the Hughes document, Serel advised the banks prior to this

meeting that Hughes had and a voting trust would be preferable to a restructure.

The banks, however, advised, according to the Hughes claim, in:

- **Under no more loan in TWA** without an immediate voting trust agreement.

- **Proceed with the Dillon, Read plan** if the insurance companies were willing to do so.

- **Other deposit balances** against out standing loans to TWA and Hughes Tool at the opening of business Oct 7 of Hughes Tool refused to accept the Dillon, Read plan.

On mid-afternoon of Oct 6, Hughes Tool representatives were called into the meeting. Serel, in spokesman according to the Hughes document, delivered what amounted to an ultimatum:

- **Hughes Tool's modified version** of the Bankers' Plan was unacceptable and no discussion of it would be permitted.

- **Voting trust** was essential and the banking group would consider no financing plan for TWA without such provision.

- **Hughes Tool had until 5 p.m.** to agree, in a document signed by Hughes himself, to the Dillon, Read plan.

Serel, according to the Hughes document, then told the Hughes Tool representatives that if such agreement was not reached he would:

- **Place Hughes Tool in receivership.**

• **Hughes' personal indebtedness** in favor of a substantial sum, would have its securities auctioned and Serel would proceed with a private financing of Hughes' stock in Hughes Tool which had been pledged in security for the debt.

By 5 p.m. Hughes had capitulated. De so it seemed. One exception was made, however. Hughes also said that TWA and Hughes Tool be permitted to pay off the total amount of the debt at 100% of the principal plus accrued interest. To that the banks agreed, the Hughes document said, and so did a representative of Equitable, in principle.

When Metropolitan was consulted, a new check was developed. The second insurance lender wanted a 23% initial penalty for preparation of the new note, plus accrued interest—\$23,000,000.

Hughes Tool continued with a new proposal to Equitable which contained a voting trust but no penalty. To replace Metropolitan's participation, Hughes Tool would take \$27.5 million of the balance due to the insurance companies were to be. Irving personally refused to consider the plan, the Hughes document said, "as the ground that it and its associated banks did not want to do business with Hughes."

Though technically past the deadline

for acceptance, the Dillon, Read plan was not dead. On Oct 19 Equitable and Metropolitan told Hughes Tool and TWA, according to the Hughes document, that they were willing to restructure the plan. They now had down as conditions:

- **Voting trust** for Hughes' TWA stock.
- **Payment penalty** of 22% on \$92,500,000 of the financing initially for termination of the voting trust.

- **No change in TWA's future** pending change in the board at any time without cause and no contract with an executive officer of TWA extending beyond the next annual election of officers.

The latter, the Hughes document alleged, was sought so that the lenders could control the management and the board of TWA.

On the same day, Irving Tool and its associated banks made a similar proposal. Acceptance of Metropolitan's and Equitable's conditions were a prerequisite. Furthermore, the banks wanted Hughes compliance in writing Oct 21 or they would seek to collect collection of TWA's debts, including offering to TWA lenders they held. Hughes refused the two letters on the day of the deadline. Failing that to incorporate a reduction in the 23% provision, Hughes then agreed orally with Irving to put the proposals before

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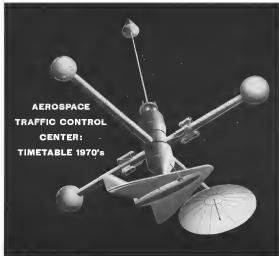
Two posters were mounted up in connection with the famous "Cook Nobs Murder". Their statements were as follows: A: "C and D are lying" B: "A and E are lying" C: "B and D are lying" D: "C and E are lying" E: "A and D are lying" Who is lying?

—Continued—

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TWA's board with full powers Oct. 24, after Hughes Tool directors were informed they could not longer assume their seats being surrendered to Hughes Tool. On the basis, Hughes accepted the proposals.

The next development, though avoided, is not spelled out in much detail in the Hughes document. It says without elaboration that being refused to honor its agreement to permit TWA's full board to consider the Oct. 19 proposals. Therefore Hughes notified the board on Oct. 22 it no longer considered itself bound by the traditional accept and

The TWA suit reaches also, though somewhat briefly, on the Oct. 21 action. TWA's executive committee, which met that day, had full power to approve the plan, the TWA document said, but at the urging of Hughes and pressure of persons acting for him the executive committee approved the plan only on condition of later approval by the full board of directors.

"The leading institutions refused to accede to any further delay, and as a result Hughes, on Oct. 22, before the full TWA board could be convened, withdrew its letter of authorization," the TWA suit said.

With that, Hughes told Irving it intended to seek other sources of financing. Irving and some other banks then proceeded to assist TWA and Hughes Tool balances (AW Oct. 31, 1960, p. 33).

Hughes Tool was unsuccessful in its

Controversy Over 880s

Steps taken by Howard Hughes in dealing with General Dynamics Corp. as its Cosmos 880 order are cited by Time World Airlines in its October 24 issue. Cosmos 880 was in part an order for designers. According to the suit, Hughes:

- Failed to fully completed several of the line, placed some panels around them, and ordered to permit Cosmos personnel to go some time, even to provide weather protection.
- Removed four aircraft from the Cosmos line under bilateral agreement and refused to return them at the time specified.
- Unilaterally and repeatedly demanded time-consuming changes.
- Refused to permit TWA or Tool company employees to make test flights to completed aircraft or to discuss delivery and refused to sign any delivery agreement with Delta Airlines or Cosmos to establish delivery for high revenues.
- Refused to accept Cosmos' request of delivery.
- Refused to permit other airlines to test fly Hughes Tool aircraft, even though additional sales could have been made by TWA airlines.



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words for new financing. Among the issues given in the Hughes document: • **Equitable's** approval and support in traditional senior leader was required by other lenders. • **Control and direction** by Management, Equitable, and President of the market for senior debt financing. • **Attitude of the financial community.**

The Hughes document alleged the was based on erroneous assumptions resulting from misleading statements of Irving and Seid in to the disagreement over the conditional acceptance of the Oct. 19 proposals.

Among the plan resolutions was suggested by Frank Peir, Jr., New General Dynamics board chairman and member of Bank of America, one of the Irving Trust group. Both were essentially short-term plans, the TWA not said, and thus were dropped.

Peir with still no alternative and with another month gone, Hughes had reached his Associates. Hughes Trust accepted the Irving Trust plan Nov. 19, the first agreement was signed in December (AW Dec. 12, 1968, p. 25).

Even now, the TWA was alleged, Hughes used the final concentration as offered as possible. Seid's nation was suggested, proposed infrastructure claims approved by Hughes Trust had their approval withdrawn, when

for the chief financial officer of Hughes Trust to sign financial papers was withdrawn, and on the day for closing the Hughes Trust could not be reached, the TWA document said. But these obstacles finally were cleared the following day, Dec. 30, the long negotiations were at an end and Hughes no longer controlled the issue.

The Hughes document criticized the formation of the Irving Trust, and the election of new management for TWA in the early months of 1961. By May, the first phase of the Irving Trust plan was at hand, an offering of \$111,000, \$200 in TWA debentures in the even market which was to refund a \$100 million TWA note due Hughes Trust.

Hughes attempted to obtain post payment of the offering for a week in Hughes Trust might create a secondary offering of the \$100 million in debentures it was obliged to buy under the terms of the Irving Trust plan. In effect, this would have placed the entire debenture issue for sale on the open market.

The second postpayment was refused, according to the Hughes document. Hughes Trust then could be prevented from raising cash to pay off the debenture debt and end the Irving Trust.

By summer of 1961, TWA was nego-

tiating a new round of financing for an order of hundreds percent (Boeing 707's Hughes Trust, the document said, made various proposals to TWA, in provide additional capital, one of which would have given TWA an additional \$100 million in equity capital, but conditioned on termination of the Irving Trust. These offers, the document said, were allowed to expire without any negotiation. Albeit that have the most money into the courts (AW Aug. 14, p. 42).

Douglas Profit \$1.82 Million for Quarter

Douglas Aircraft Co. reported a profit of \$1.82 million for the first quarter of fiscal 1962 compared with a profit of \$1.47 million for the same quarter in 1961. The profit came from cost reductions achieved in the recent cost reduction of the company. Sales were down from \$205 million to \$164 million for the same period.

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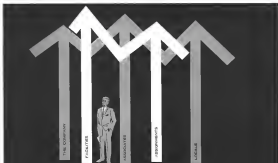
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